

\$3.20

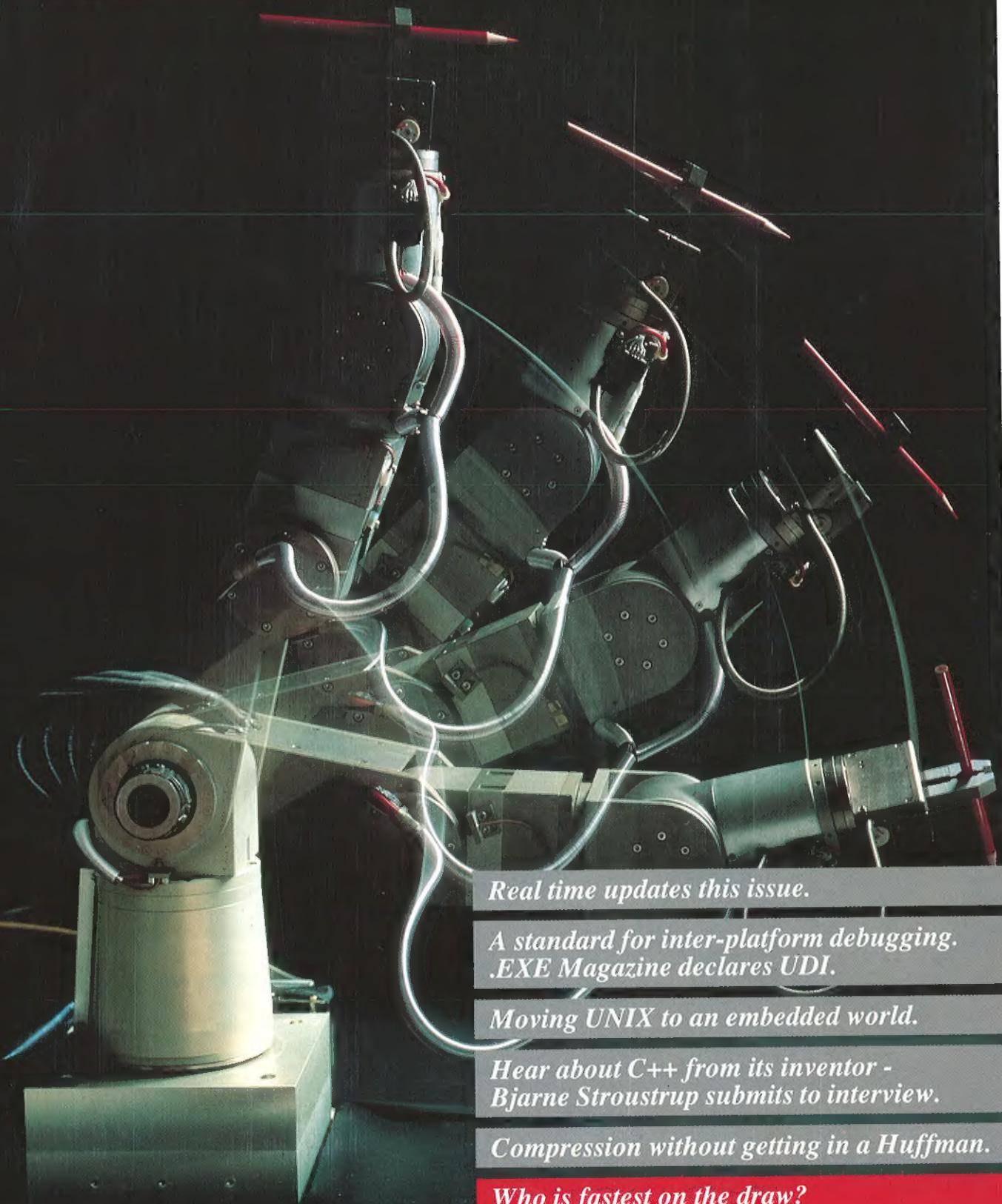
.EXE

MARCH 1992

VOL 6

ISSUE 9

The Software Developers' Magazine



Real time updates this issue.

*A standard for inter-platform debugging.
.EXE Magazine declares UDI.*

Moving UNIX to an embedded world.

*Hear about C++ from its inventor -
Bjarne Stroustrup submits to interview.*

Compression without getting in a Huffman.

*Who is fastest on the draw?
We compare five compilers' graphics.*

The best path for complete C training begins at QA

C has become the dominant language in computer programming and provides access to the software industries major application program interfaces.

C is probably now, or shortly will be, your way forward in program development – and QA can really help you along that path.

Only QA's extensive C curriculum totally supports the training needs of all C programmers, from beginner through to highly experienced professional. Each course can stand alone or can be the entry point to reach any level of skill or knowledge you may set yourself.

In common with all QA courses, our instructors are experienced professionals themselves, our training materials are perfected for efficient learning, and all our own skill and energy is channelled towards helping you get the maximum benefit from your training.

*Send for more details today or call
Samantha Trinder on 0285 655888.*



Mail to QA Training Ltd, Cecily Hill Castle, Cirencester, Gloucestershire GL7 2EF, UK.

Tick here for details:

TRAINING: C Pascal Masm Object-Oriented Networks UNIX/AIX OS/2 Windows
 CONSULTANCY
 SOFTWARE DEVELOPMENT PRODUCTS

NAME

TITLE

COMPANY

ADDRESS

TEL. NO.

AEX01

BEGINNERS START HERE

C Primer
2 days

- Introduction to HLL concepts via C
- An overview of the C programming environment
- Developing simple C programs
- Data typing, block structure, scope concepts
- Introducing C functions and modular programming
- How to use the C library and preprocessor
- Working with larger programs
- Introduction to advanced techniques

OTHERS START HERE

C Programming
4 days

- C program structure and style
- Data types and variables
- Flow of control in C programs
- Pointers and address manipulation
- Portability and efficiency considerations
- Debugging C programs
- Working with larger C programs

OR ANYWHERE

Advanced C
4 days
C review

- Common problems
- ANSI features
- Advanced pointers
- Standard library
- Dynamic memory techniques
- Efficiency and optimisation

ELSE

C++ Programming
4 days

- C++ today
- Declaring and using classes
- Operator and function overloading
- C++ advanced syntax concepts
- Single and multiple inheritance
- Performance considerations
- Class libraries and application frameworks
- OOP: the benefits and pitfalls

ALSO

PASCAL

Pascal Programming
4 days

- Structured programming style
- Data types, variable declarations
- Statements and expressions
- Decision and repetition in Pascal
- Arrays, records and files
- Pascal development tools and libraries
- Common extensions

MASM

Masm Programming
4 days

- 8088/86/286 architecture
- MASM program structure and style
- Interrupt handling
- 8088/86/286 instructions
- Advanced segmentation
- Modular program development
- Interfacing to high level languages
- 80286/386 overview

QA
TRAINING

**C Programming Training
For All Levels**

CIRCLE NO. 535

| | |
|--|-------------------------------|
| Editor: | Willie Watts |
| Features Editor: | Paul Kemp |
| Staff Writer: | Cliff Saran |
| Production Manager: | Katerina Adams |
| Design & Layout: | Mark English |
| Group Advertising Manager: | Sandra Inniss-Palmer |
| Assistant Advertising Manager: | Ed Butcher |
| Advertising Executive: | Marc Warren |
| Reader Services & Promotions: | Helena Adams |
| Administration/Subscriptions: | Rena Gibbs Sandy McDonnell |

Front Cover Photograph courtesy of Fujitsu Ltd

General

.EXE Magazine is independent and not affiliated to any vendor of hardware, software or services. It is published by Process Communications Ltd, 10 Barley Mow Passage, Chiswick, London W4 4PH.

Tel: (Advertising/Editorial/Production) 081 994 6477

(Subscriptions) 0442 824501

Facsimile: 081 994 1533 Telex: 8811418 SPACES G

ISSN: 0268-6872

Subscriptions

.EXE Magazine is a monthly journal for software developers. It is available only by subscription, at a cost of £35 per annum (11 issues) in the UK, £50 for 2 years. Overseas subscriptions cost £45 per annum, £70 for 2 years. A subscription implies that this journal will be sent to the subscriber until one of the three expires' - AG Macdonell. The magazine is published around the 26th of the month preceding the cover date. There is no January issue. To subscribe or obtain details of overseas/academic rates, please call 044282 4501, or write to The Subscriptions Manager, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. We can invoice your company or take ACCESS and VISA cards. In case of a query about your subscription, please call 044282 4501.

Back issues are available at a cost of £3.50 each - call our Chiswick office (081 994 6477) for a list of issues still in print.

Editorial

Editorial enquiries should be addressed to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. We welcome letters, opinions, suggestions and articles from our readers. Please write for a copy of our Contributors' Guide.

Information contained in .EXE is believed to be correct. If errors are found, we will endeavour to publish a clarification in the next available issue.

From time to time, we offer to copy the PC program code described in an article onto diskette for our readers. In this case, please send a blank, formatted disk with a self-addressed, prepaid mailer to the editorial address given above. We can copy both 5.25" and 3.5" disks.

The publishers can accept no liability for any consequences of using software distributed in this way.

Advertising

If you are interested in advertising in this magazine, please write to the Display Advertising Manager/Recruitment Sales Manager (as appropriate), .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH, or call 081 994 6477 for details of our advertising rates.

Pronunciation

.EXE Magazine rhymes with 'not sexy magazine'.

Copyright

Material published in .EXE Magazine is copyright © Process Communications Ltd. Articles (or parts of articles) may not be copied, distributed or republished without written permission from the publishers. All trademarks are acknowledged as the property of their respective owners.

Issue theme: Developing for Real Time**'TWIXT HOST AND TARGET**

Daniel Mann looks at a Standard designed to improve real time debugging.

12**A UNIX FIT TO EMBED**

David Hann slims down UNIX for real time.

21**DON'T DIY**

Steve Montgomery argues against home-made kernels.

24**YET MORE Bjarne**

C++ maestro Bjarne Stroustrup talks to .EXE Magazine.

30**LIFE WITHOUT HUFFMAN**

Crosbie Fitch's alternative data compression algorithm.

39**THE FASTEST DRAW**

Cliff Saran compares C compiler graphics among the DOS Big Five.

44**COMPLETE CONTROL**

Paul Kemp has a kit for decorating dingy dialogs.

52**SOAPBOX**

Making private C++ data really private.

2**NEWS**

SQL Server leapfrogs version numbers, SCO's new UNIX.

4**LETTERS**

Working out the uses of VR, Borland's bug list and editorial Humble Pie.

10**MAYHEM**

Computer salespersons cross swords with Mr May.

56**LAINE STUMP'S C++ DIARY**

Our diarist suggests five design guidelines for classes.

59**IC**

John Davies gives the PC UART terminal treatment.

65**xBASE**

Larry Adlard has unscrambled Paradox data files.

71**UNIX REGULAR**

Peter Collinson provides how? and why? on virtual paging.

78**BOOKS**

Books on C++ style and the design of both flavours of OS/2.

84**CUG**

Francis Glassborow visits the Standards-making factory.

86**ECUG**

Mike Banahan introduces a Euro-alternative to CUG.

88**CROSSWORD**

Eric Deeson delivers more puzzlement.

88**STOB**

Verity discovers the essence of a good book.

96

Censoring C++

Paul Kemp's no prude but he finds C++ classes in need of a fig leaf.

I have a problem with private parts. Well, those of C++ classes to be precise. The problem is partly aesthetic and partly practical. Let's start with the cosmetics. If the behaviour and usage of a C++ object is entirely defined by its `public` and `protected` interface, then why is its `private` data so unashamedly exposed in the class declaration? The internal implementation of a class is (or should be) of no interest to the user of that class. This is one of the most fundamental concepts in object-oriented programming - yes, that old chestnut data abstraction or encapsulation. Not only is it unnecessary to see `private` data and methods, but their presence in a class declaration can be confusing and obscure the use of the object, especially if there are a lot of them.

The practical difficulties lie in the fact that the 'visibility' of this `private` data compromises the maintainability of application code. It is part of a wider problem associated with developing and maintaining large C++ systems. To be fair, the problem is partially to do with the current set of development tools available to C++ programmers. Large applications have many classes with complex and far-reaching interdependencies. Changes in the design of classes (a *very* frequent occurrence in the initial stages of development) will inevitably necessitate the recompilation of source code.

Unfortunately, because many classes are dependent on other classes this can lead to a domino effect, whereby a minor change to a class declaration can leave the programmer staring blankly at his screen while half of his application code is recompiled. What C++ programmers obviously need is an intelligent `make` utility capable of figuring out what needs to be recompiled and what doesn't. Working this out for yourself and hand coding the appropriate `make` file is about as exciting as using a CASE tool.

Design changes that affect the `public` interface of a class are pretty fundamental and the programmer will have to accept the consequences, but `private` data is implementation-specific and should not affect the *users* of a class (the client code). Unhappily this is not the case. If the visible `private` data of a library class is modified (for example, because the *implementation* of a `public` member function has changed) then all of the application code which uses that class must be recompiled. So much for data abstraction. During the suck-it-and-see design phase of a C++ project the problem of cascading recompilations can become quite intolerable.

Faced with these problems on a sizeable project (and being far too `lazy` pressed for time to do the complicated `make` file), a colleague and I developed a simple but effective technique. Undoubtedly variations of it have been considered and used by other C++ developers. Like many programming techniques, it is a trade-off between elegance and efficiency. In brief, the 'visible' `private` data of all classes is reduced to a single, abstract `void` pointer. This in fact points to a `struct` which contains the *real* `private` data items. In the header file, for example:

```
class obj
{
private:
    void * pData;
public:
    obj( int data );
    ~obj();
    int GetData();
};
```

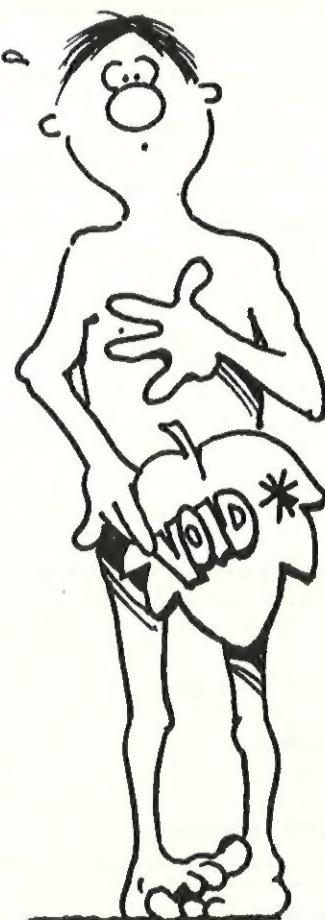
The `struct` containing the real data is defined in the source file which implements the class's methods, and only has scope within that source file. The object's constructor allocates memory for this structure and saves the pointer in `pData`. Member functions that wish to access any item of `private` data must declare a pointer to the real data `struct` and cast `pData` to the appropriate type. Hence in the source file:

```
struct Imp
{
    int val;
};

obj::obj( int data )
{
    Imp * p = new Imp;
    pData = (void *)p;
    p->val = data;
}

obj::~obj()
{
    Imp * p = (Imp *)pData;
    delete p;
}

int obj::GetData()
{
    Imp * p = (Imp *)pData;
    return p->val;
}
```



When using this technique, `private` data (contained within the `Imp` structure) can be changed at will without any modifications to the header file, thus avoiding knock-on recompilations.

Of course there are overheads and restrictions. Class definitions must be kept in a separate header file from their source and you can't have any inline functions which access the real `private` data.

When you do wish to access the class' `private` data items, there is the overhead of an additional level of indirection (`p->`). The constructor also has the overhead of dynamically allocating memory for the data items on the heap. Remember a destructor must also be provided which frees this memory.

The technique doesn't hide `private` member functions and is probably only appropriate for complex classes, but it can help C++ developers to avoid the 'domino effect'. So cover up your `private` parts - modesty is sometimes the best policy.

EXE

Special thanks to Peter Sabine-Bacon whose bright idea this was.

DEBUGGING TOOLS

NEW SOFT-ICE/W lets you debug VxD's, drivers and interrupt routines at source level, interactions between DOS TSR's and Windows Apps, programs in DOS boxes and displays valuable system information (including the complex internal structures of Windows). **EVERY WINDOWS PROGRAMMER SHOULD HAVE ONE. CALL US NOW.**

| | | |
|---------------------------|---------|------|
| Bounds Checker | 386 | £220 |
| Multiscope for DOS | DOS | £140 |
| Multiscope for Windows | Win&DOS | £270 |
| Multiscope for OS/2 | OS/2 | £315 |
| Periscope I/512K | DOS | £490 |
| Periscope II | DOS | £150 |
| Periscope II-X | DOS | £130 |
| Periscope/EM | 386 | £195 |
| Quaid Analyser | DOS | £130 |
| Soft-ICE | 386 | £340 |
| Soft-ICE/W | Win-386 | £340 |
| Soft-ICE & Bounds Checker | 386 | £470 |

PROGRAMMING TOOLS

| | |
|-------------------------|------------------------|
| Ada | Algol |
| Assemblers | AWK |
| Basic | C |
| C++ | Cobol |
| Comal | Comms |
| Cross Dev | Database |
| Debuggers | Editors |
| Forth | Fortran |
| Graphics | Icon |
| Linkers/Locators | Lisp |
| Logo | Modula-2 |
| Pascal | Prolog |
| Rexx | Smalltalk |
| Snobol4 | Version Control |
| Windows | Yacc & Lex |

We stock many items for which there is no space in these advertisements.

ADA COMPILERS

SPECIAL PRICE OF £60 FOR LIMITED PERIOD ONLY on the validated Janus/Ada Compiler. If you want to learn Ada, do it now.

| | | |
|--------------------|----------|------|
| Janus/Ada Compiler | DOS | £60 |
| Janus/Ada PDS | 386->DOS | £385 |
| OpenAda DOS | DOS | £260 |

GENERAL PROGRAMMERS UTILITIES

Source Doc/Xref/Pretty Printers

| | | |
|------------------|---------|------|
| Flowcharting III | DOS | £175 |
| Easyflow V7 | DOS | £180 |
| SourceDoc | OS2&DOS | £270 |
| Source Print | DOS | £75 |
| Tree Diagrammer | DOS | £75 |
| RFFlow 2.0 | Win | £92 |

Make/Version Control

| | | |
|----------------------------|-----|------|
| MKS RCS | DOS | £165 |
| MKS Make | DOS | £100 |
| PVCS Version Manager | DOS | £390 |
| PVCS Config Builder | DOS | £165 |
| SMS | DOS | £445 |
| Sorcerer's Apprentice Prof | DOS | £429 |
| TLIB 4.12 | DOS | £65 |

BASIC FOR WINDOWS

NEW REALIZER from Within Technologies must be the most complete development tool for Windows - includes support for Forms, Spreadsheets, Charts, Text Editing, Animation & Graphics. **CALL US NOW FOR MORE DETAILS.**

| | | |
|-----------------------|-----|------|
| GFA-BASIC for Windows | Win | £170 |
| MS Visual Basic | Win | £95 |
| Realizer | Win | £275 |

Visual Basic Libraries

| | | |
|--------------------------|-----|------|
| Comms Lib (Microhelp) | Win | £95 |
| PDQ Comm for Windows | Win | £70 |
| VB/ISAM | Win | £69 |
| Btrieve v5.1 | Win | £345 |
| CodeBase 4.5 | Win | £215 |
| MS VB Lib for SQL Server | Win | £300 |
| ObjectTrieve/VB | Win | £250 |
| PowerLibW | Win | £195 |
| Raima Data Manager | Win | £245 |
| Graphics Server for VB | Win | £85 |
| PowerShow | Win | £325 |
| Microhelp Muscle | Win | £125 |
| QuickPak Pro for Windows | Win | £135 |
| VBTools (Microhelp) | Win | £95 |

GREY MATTER

Prigg Meadow, Astburton, Devon TQ13 2DF

Prices do not include VAT or other local taxes, but do include delivery in the UK and Europe.
Please check prices at time of order as ads are prepared some weeks before publication.

This page lists some of our products - call us for a complete price list and details of discount structure.
ORDER BY PHONE WITH YOUR CREDIT CARD.

TEL: (0364) 53499

FAX: (0364) 53071

C & C++ COMPILERS

NEW MICROSOFT C/C++ 7 should be shipping at the beginning of March. READ THE REVIEWS. Then buy one from us - we are taking advance orders now.

SPECIAL MICROSOFT C/C++ 7 UPGRADE - ONLY £99 for existing owners of Microsoft C, Borland/Turbo C++, Zortech C++ or Topspeed C++ (any version). Simply send proof of purchase (must be dated before 1 Feb 92).

SPECIAL BORLAND C++ & AFX UPGRADE - ONLY £189 for existing owners of any C or C++ from Microsoft, Zortech or Topspeed.

| | | |
|--------------------------|-------------|------|
| Aztec C86-C | DOS | £260 |
| Borland C++ 3.0 | Win&DOS | £199 |
| Borland C++ & AFX 3.0 | Win&DOS | £295 |
| Borland C++ & AFX U/G | Win&DOS | £189 |
| Microsoft C 6.0 | OS2&Win&DOS | £222 |
| Microsoft C/C++ 7.0 | Win&DOS | £222 |
| Microsoft C/C++ Upgrade | Win&DOS | £99 |
| MS C & Win SDK | OS2&Win&DOS | £335 |
| MS QuickC 2.5 | DOS | £50 |
| MS QuickC & QuickAsm | DOS | £83 |
| MS QuickC for Windows | Win | £95 |
| Topspeed C Prof | Win&DOS | £165 |
| Topspeed C++ Prof | Win&DOS | £165 |
| Turbo C++ | DOS | £50 |
| Turbo C++ & Turbo Vision | DOS | £69 |
| Turbo C++ for Windows | Win | £85 |
| Watcom C 8.5 | OS2&Win&DOS | £275 |
| Zortech C++ | Win&DOS | £370 |
| Zortech C++ S&E | Win&DOS | £550 |
| High C 386 Local 1.7 | PL386 | £585 |
| High C 386 Global 2.3 | PL386 | £650 |
| Intel 386 C Code Builder | Win&386 | £399 |
| NDP 386 C | | £86 |
| Watcom C 8.5/386 | Win&386 | £495 |

PROGRAM EDITORS

NEW MULTI-EDIT V6 includes new C-like macro language, real-time DOS output window, faster virtual memory manager, binary & Unix file editing, XMS support, etc, etc. **CALL US FOR MORE DETAILS, including update pricing.**

NEW MULTI-EDIT LITE must be the bargain editor of the year! No macro language, but most other features of Standard. **ONLY £49.**

OTHER NEW MULTI-EDIT ADD-ONS: **MULTI-TAGS** hypertext source code browser @ £29, **EVOLVE** for dBase or Clipper @ £65, **GUIDE.2** context-sensitive on-line hypertext reference manual for C++ @ £35 or **Turbo Pascal 6** @ £20.

| | | |
|----------------------------|-----|------|
| Brief | DOS | £199 |
| EC Editor | DOS | £40 |
| Epsilon v5 | DOS | £155 |
| Kedit v4 | DOS | £95 |
| Multi-Edit Lite v6 | DOS | £49 |
| Multi-Edit Standard v6 | DOS | £75 |
| Multi-Edit Professional v6 | DOS | £110 |
| Norton Editor v2 | DOS | £45 |
| PVCS Prof Editor | DOS | £195 |
| QEdit Advanced | DOS | £45 |
| Vedit-Plus v3.5 | DOS | £120 |

For more information please call us.

FORTRAN COMPILERS

| | | |
|--------------------------|-------------|------|
| FS-Fortran 77 | DOS | £34 |
| Lahey F77L 5.0 | DOS | £420 |
| Lahey Personal Fortran | DOS | £85 |
| LPI RM/FORTRAN 3.1 | DOS | £535 |
| MS Fortran 5.1 | OS2&Win&DOS | £205 |
| Prospero Fortran | DOS | £145 |
| Prospero PC Fortran | DOS | £55 |
| Watcom F77 8.5 | OS2&Win&DOS | £295 |
| FTN77/386 | | £765 |
| FTN77/486 | | £895 |
| Lahey F77-EM/32 & OS/386 | | £895 |
| Watcom F77/386 8.5 | Win&386 | £495 |

We also stock a range of Fortran Libraries.

DISK COPYING

We can copy files to and from 600 disk formats including CP/M, CP/M-86, MS-DOS, PC-DOS, APPLE, SIRIUS, BBC, TORCH, APRICOT, HP-150, TRSDOS, AMSTRAD, ATARIST, MACINTOSH. Our charge is £10.00 + disk + VAT with discounts on small quantities and disks are normally despatched within 24hrs of receipt.

For more information call us.

WITH FULL TECHNICAL SUPPORT

Actor 4.0

Version 4.0 of Whitewater's thespian OOP language incorporates database-independent SQL libraries and DLLs for Paradox, Excel, SQL Server, dBASE, DB2, Oracle and OS/2 Extended Edition. Improvements have also been made in the ObjectWindows class library. Plain vanilla Actor 4.0 costs £129 or £375 for the full-blown Professional development system. Now markets the product in the UK on 0628 668334.

New Home for FG

Zortech's Flash Graphics library has been revitalised, thanks to a new company called FlashTek. As a result of Symantec's acquisition of Zortech in September 1991, Joe Huffman, the original author of FG, has modified the library so that it can be used with the Borland C++ compiler. There are also plans to release a BGI interface to the Flash Graphics engine which will enable applications written using BGI to be re-compiled with FG. Flash Graphics is produced by FlashTek on 0476 74108 and costs £110.

Deal on BC++

With the imminent release of Microsoft C V7.0, Borland has introduced a special offer on the Borland C++ V3.0 with Application Framework package. In the same vein as Microsoft, Borland is tempting users of Microsoft C, Quick C, Zortech C++ and JPI with an attractive upgrade price of £189.95 (RRP of BC++ with Application Framework is £439.95). Borland can be contacted on 0734 320022.

Parallel C++

Packaged as an add-on to 3L's Parallel C compiler, Parallel C++ is a front-end-based implementation of AT&T's C++ V2.1 language specification. Designed for developing transputer-hosted applications, Parallel C++ costs £295 and requires a copy of Parallel C. Users who don't already have 3L's C compiler can get both products bundled for £795. 3L is on 0506 415959.

HP graphics

Workstation Source has introduced HT BASIC V3.3, a compiler which enables programs written using HP Rocky Mountain BASIC to be compiled and run under DOS. The new version supports loadable device drivers for keyboard, display and HPGL hardcopy devices. A 32-bit, VCPI and DPMI compatible version of the compiler is also available. HT BASIC for DOS costs £495. The 32-bit HT BASIC 386 costs £695. Workstation Source is on 0628 75252.

HP's USL C++

Unix System Laboratories announced that it will be using the C++ exception handling technology developed by Hewlett-Packard in its forthcoming USL C++ Language System. Exception handling is also featured in HP's own new C++ compiler (HP C++ V3.0). HP has stated that its new C++ compiler provides '...the first exception handling facilities for a C++ compiler'.

'We are offering C++ V3.0 on the heels of USL's announcement of its C++ Language System Release 3.0,' added Richard Owen (HP's Workstation Marketing Manager), 'making us the first vendor to put some of these key new technologies into developers' hands.'

The lack of exception handling is generally acknowledged to be an important flaw in the present Release 3.0 C++ programming model. HP C++ V3.0 will be available in the second quarter of 1992 for the HP9000 series 700 workstations at a cost of £1,950 for a one-seat licence. Hewlett-Packard is on 0344 369369.

Soft Disk Mirror

Recovery is a LAN utility which provides disk-mirroring in software. It can be run from any workstation and works by continually analysing the source and destination drives. Files that have been modified since the last time the mirror was performed are copied from the source drive (which may be any logical drive including virtual disks, floppy disks and hard disks) to the destination mirror drive. If a file is busy it is picked up the next time through the mirror process which continues until all the files have been copied (or until it is stopped by the user). It is possible to specify a datestamp for copying only the most recent files.

During disk-mirroring, Recovery provides the user with various information including a list of files that have been copied and a list of files remaining. Recovery is priced at \$99 and is distributed by Nonstop Networks Ltd on 0101 212 4818488.

Enhanced Empress

The Empress Database Server is the latest addition to the Empress RDBMS. It achieves increased performance by utilising the Internet protocol for communicating over LANs, instead of relying on an underlying filing system such as NFS.

Database server is able to take advantage of multi-processor hardware and, using a Global Data Dictionary, it enables transparent access to distributed databases. It provides a server spooler which accepts database requests from clients for one or more databases. Each request is assigned a sub-process which may be executed on a separate CPU. The sub-process accesses the Empress RDBMS and returns information directly to the client.

Database Server is included with the latest version of the Empress RDBMS which costs £7000 for the Sun2 developer's edition. Empress Software can be reached on 0483 861990.

E-Mail DLL

Finansa Ltd has announced that its new WinMail V1.0 product is the first E-Mail package to be distributed as a DLL. WinMail supports Novell's Message Handling Service V1.1 which provides compatibility with over 100 gateways including Fax, Telex, Pager and mail from IBM, UNIX and Macintosh etc. Incoming mail is automatically put into categorised folders, based on sender etc. An Address Book is provided and WinMail can be configured to delete junk-mail automatically. The WinMail API is also included. A five-user version of WinMail V1.0 is priced at £395 (10-user version costs £695). For more information contact Finansa on 0582 662268.

Multi-user PC

Technology Concepts Ltd has developed PCC/MX, a multiple serial port device that lets up to eight users/terminals connect to a central PC. Unlike standard serial port cards, the PCC/MX consists of two parts. Internally, the PC is fitted with the PCC/SYNC processor card containing a 16 MHz 80186 processor and 512 KB of RAM. The processor card is used to coordinate the activities of two PCC/MXs. Each PCC/MX consists of eight V.24/RS232 serial ports and a parallel printer port. Technology Concepts claims that the PCC/MX comms line 'runs at speeds up to 1MHz', and, '...individual terminals can be sited up to 30m from it'.

The PCC/MX also offers remote connections using high speed modems and four units can be linked together, supporting a total of 32 users.

Device drivers are available for several operating systems including XENIX, CDOS, PC MOS and OS/9000. The PCC/MX costs £1425 and includes the PCC/SYN front-end processor card which supports two PCC/MX units. For more information contact Technology Concepts Ltd on 0633 872611.

GREAT PERFORMANCE GETS YOUR ATTENTION GREAT TECHNOLOGY KEEPS IT

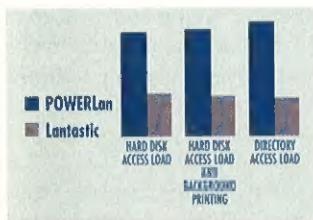
POWERlan

DOS Networking

"POWERlan swept all of the performance categories on our benchmark tests."

"If you need to link DOS, OS/2, Unix, and other platforms in an interoperable network ... POWERlan is the product to choose"

"you can't ignore this powerhouse, POWERlan's features speak for themselves; its speed convinces"



June 25, 1991
POWERlan, Version 2.10

CIRCLE NO. 537

POWERsave

Network Backup

"This is the fastest single-file restore we found in any of the systems, including server-based units. We didn't believe it either until we ran the test three times."

"simple to use"

"Performance Technology may have the fastest workstation-based drive in Netwaredom."

"offers excellent progress tracking"

"operates ... at warp speed"

LAN Times, June 17, 1991



Sure, we like to make products that go fast. But, performance is just one quality we take seriously. Operating in multi-vendor environments is high on our list too. And there's lots more. Call us to get the rest of the story.

POWERfusion

DOS - UNIX Connection

"In our benchmark tests, Performance Technology lived up to its name."

"... the POWERfusion family can support large networks of busy users and still deliver"

"If you're looking for a way to connect your Unix box to a network of DOS-based PCs, look no further."



May 28, 1991
POWERfusion, Version 1.3

BYTE, March 1991

"Performance Technology is selling glue technology that can help solve a variety of local- and wide-area networking problems. Lord knows, that's something we all need."

POWERbridge

LAN to LAN Connection

"Usually I wonder about a product that has "power" associated with it, but POWERbridge ... deserves the honor."

"POWERbridge supports nine operating systems ... links all the networks you'll ever have."

LAN Times, February 4, 1991

"... well, you haven't lived until ... (you) ... hop through a NetWare LAN to an SMB server running under Unix" (with POWERbridge)

BYTE, March 1991



AUTOMATED OFFICE SYSTEMS
COMPUTER SOFTWARE DEVELOPMENT



C.M.S. SOFTWARE LTD

A. O. S. SOFTWARE DEVELOPMENT
First Floor, 46A Chiswick High Road,
Chiswick, London W4 1SZ
Telephone: 081 995 7716
Facsimile: 081 995 7865



PC NeXT

NeXT Computer Inc has unveiled NeXTstep 486, a version of the company's UNIXish object-oriented system software that runs on Intel 80486-based machines. NeXT's own machines are based on the powerful Motorola 68040 chip. NeXTstep 486 will be offered in two versions: a user version retailing at £695 and a developer version, price to be confirmed. Both will be distributed on CD-ROM media. System requirements are pretty hefty with 8-16 MB RAM and 400 MB disk space needed for the developer version. Contact NeXT for more info on 081 5650005.

C + C++ = ?

Supporters of C and C++ will soon be brought together in a new, all encompassing conference which has been given the tongue-twisting title of 'C Plus C++ in Action'. The conference will take place on the 8-12 June 1992 at the London Gatwick Airport Hilton. There will be over forty tutorials and discussions on such issues as Advanced C Language Topics, Transition from C to C++ and Object-Oriented Analysis and Design. Details of the conference can be obtained from the Boston University Conference Office on 071 2592032.

Tool up

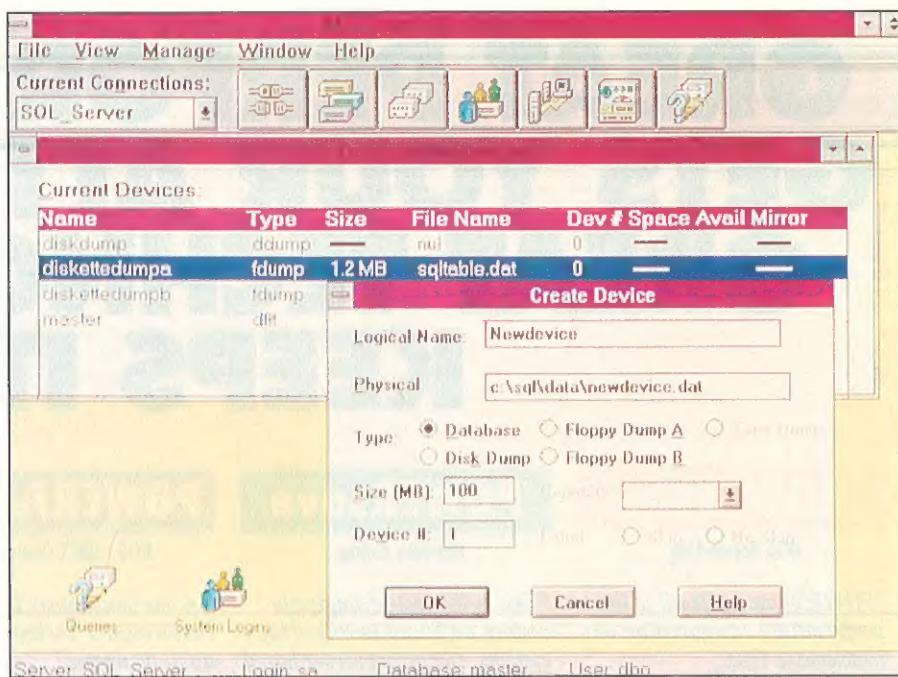
OOP Messiah Bertrand Meyer will be chairing the 7th International Conference & Exhibition of Technology of Object-Oriented Languages and Systems. TOOLS Europe '92 will be held in Westfalenhalle Dortmund, Germany from 30 March - 2 April, 1992. Phone: 010 33 45325880, Fax: 010 33 45325881 or Email: tools@eiffel.fr.

CodeBase offer

Get a free copy of Borland's Turbo C++ compiler and 'World of C++' video when you purchase both Sequitur Software's CodeTranslator V1.0 (RRP £129) and CodeBase V4.5 (RRP £255) from The Software Construction Company at a combined cost of £385. The Software Construction Company is on 0763 244114.

310 ASM progs

The latest release of the ASM Utility Library from EMS contains a total of 310 shareware programs distributed on eight 1.44 MB diskettes and requires over 25 MB of disk space. EMS provides a handy lookup program which helps you to find a given utility quickly. The ASM library covers many subject areas including BIOS, Compression, Networks and TSRs. The ASM Utility Library costs \$59.50. Contact EMS professional Shareware Libraries on 0101 301 9243594.



Giant leap for SQL Server

Microsoft's strategic client/server database SQL Server has leapfrogged in version number from the current V1.11 to V4.2.

The renumbering reflects the inclusion of all core features found in Sybase versions of the product for UNIX and VMS platforms. Microsoft has stated that the numbering is consistent with Sybase and represents the commitment by Microsoft and Sybase to deliver the same features in all versions of SQL Server.

New facilities in V4.2 include database device mirroring for fault tolerance, cascading triggers, online dynamic tape backup, placement of tables on specific devices and increases in overall system capacity. A Windows-hosted server administration tool (see picture) is also included which should simplify configuration, tuning and backup of SQL Server systems. The most significant enhancement for programmers is the inclusion of support for scrollable database cursors. Cursor support greatly simplifies the development of data browsing applications with the ability to scroll backwards and forwards through row-level data. Positioned updates and deletes may also be performed.

Also included in the box are a hardware-independent version of OS/2 and the Open Data Services (ODS) toolkit. ODS allows the development of SQL Server gateways and extensions to interface with disparate data sources on other platforms such as VMS, UNIX, MVS and VM. ODS applications can be triggered by remote stored procedure calls from SQL Server.

The connectivity of SQL Server has also been extended with the availability of Gateway Link/Gateway Services from SQL Solutions, a subsidiary of Sybase, and Microsoft's SQL Bridge. Gateway Link is built using ODS technology and allows SQL Server front-end applications to access VMS and UNIX-based minicomputer databases like Oracle, Ingres, Informix and VAX RMS. SQL Bridge is a two-way network gateway that connects Microsoft SQL Server and Sybase SQL Server environments, allowing clients and servers to communicate across different networks. This means that UNIX, Macintosh and VMS clients can now access data on Microsoft's OS/2-based version of SQL Server.

SQL Server and LAN Manager are Microsoft's only remaining ties with the operating system *non grata* OS/2. While a Windows NT version of SQL Server is in the pipeline, it is still fairly embryonic, and Microsoft has stated that it will continue to support OS/2 as a client and server platform. Support for OS/2 2.0 clients has been promised but Microsoft was non-committal on the subject of whether SQL Server would be revamped to take advantage of OS/2 2.0's 32-bit API.

SQL Server V4.2 prices start at £2,295 for a 10-user server pack with a free upgrade for existing users of V1.11. SQL Bridge costs £1,995. Gateway Link is available from SQL Solutions for £3,000 and retail prices for the various Gateway Services range from £15,640 to £100,000 depending on the hardware platform and the number of users. SQL Solutions is on 0344 360101 and Microsoft is on 0734 270000.

Who put C++ to Work?



glockenspiel class constructors

Glockenspiel C++

Glockenspiel C++ leads the field in object-oriented programming. It's the most effective and efficient implementation around. It conforms exactly to the AT&T C++ specification – and they don't come any closer than that! Portable too: it's on more platforms than any other C++ implementation.

Glockenspiel CommonView®

Glockenspiel CommonView is the leading C++ class library for developing Windows, PM and OSF/Motif applications. Logical, well structured and easy to use, CommonView is 3 to 5 times more productive than the API.

C++ Training & Consultancy

Glockenspiel C++ training courses reflect our experience as C++ developers. From design to development, *learn from the best!*

Our C++ consultancy services match your needs as you commit more resources to C++ and object-oriented development.

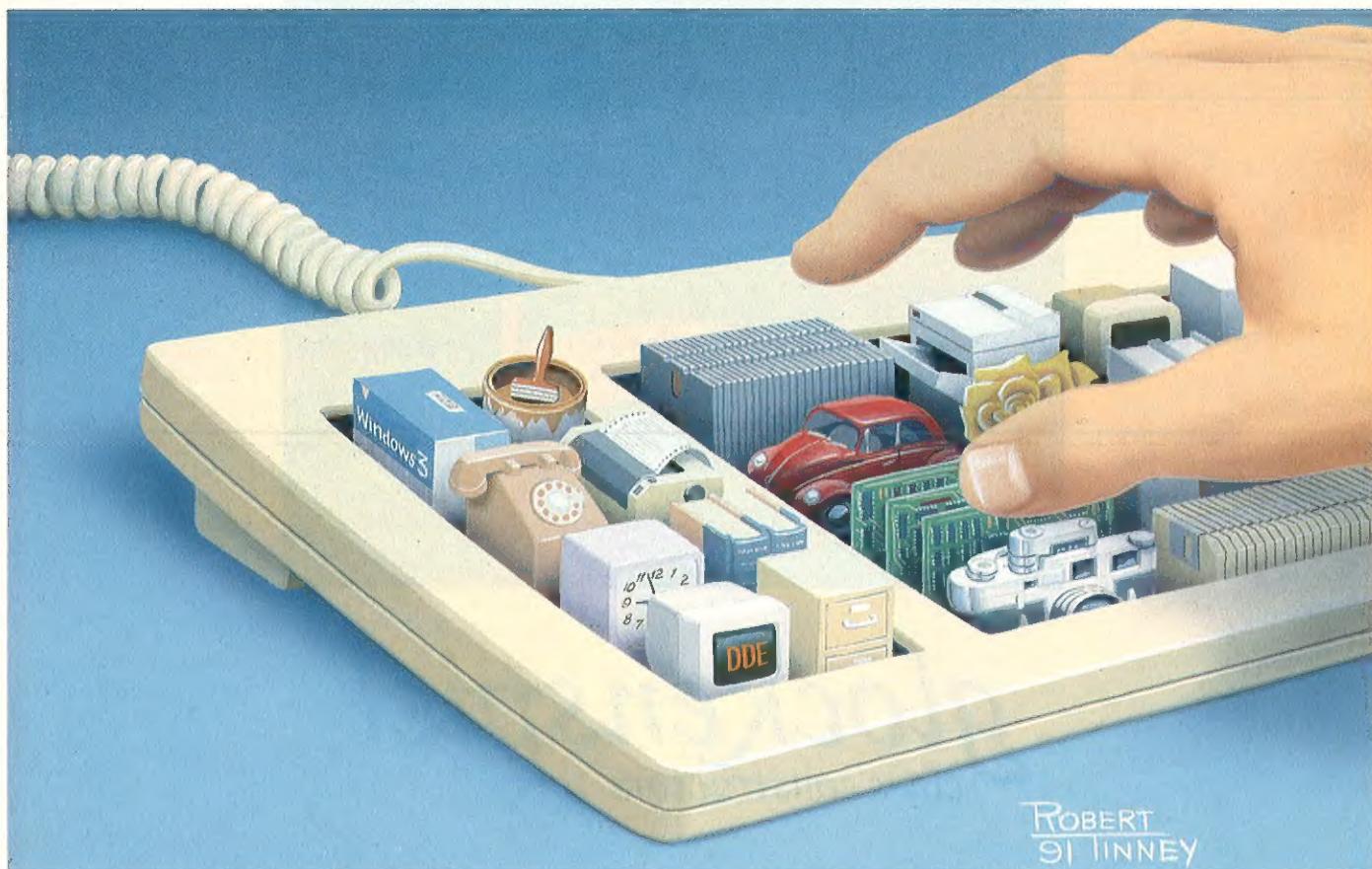
Further Information

GLOCKENSPIEL, 39 Lower Dominick Street, Dublin 1, Ireland. +353 (1) 733166. Fax +353 (1) 733034

■ US: **IMAGESOFT**, (516) 767-2233. Fax (516) 767-9067. **OASYS**, (617) 862-2002. Fax (617) 863-2633 ■ UK: **QA TRAINING LTD.**, (0285) 655888. Fax (0285) 650537.
■ Italy: **INFERENTIA**, (02) 26680568. Fax (02) 2364258. ■ Sweden: **LINSOFT**, (01) 3124780. Fax (01) 3152429. ■ Germany, Switzerland, Austria: **PSI**, (06021) 492-0. Fax (06021) 492-112
■ Benelux: **RIJNHAAVE**, +31 (71) 218121. Fax +31 (71) 216118

Glockenspiel CommonView and Glockenspiel C++ are registered trademarks of Glockenspiel Ltd. The trademarks of their respective corporations are acknowledged.
Glockenspiel "Colour Rotation" logo by Francis Tansey

Objects At Your Fingertips.



ROBERT
STINNEY

Now, if you want to develop applications for Windows 3.0, there's a fast and easier way to do it with the premier object-oriented programming language. Smalltalk/V.[®]

With Smalltalk/V Windows, you can explore, prototype, build finished applications and ship them runtime free.

You can tap into applications using DDE so effortlessly you don't have to be a Windows expert to do it.

And with one of the world's most comprehensive class libraries, you can

choose our objects or easily build your own.

But whatever you develop, it will be portable between the Windows, OS/2 and Mac versions of Smalltalk/V.

With so much at their fingertips, more people are solving more problems with Smalltalk/V than any other object-oriented programming system.

At only £330 + VAT and no runtime charges, you can solve them, too.

Just call us at 071-436 9481. And see why programming Windows has never been easier.

Smalltalk/V Windows

COCKING & DRURY (SOFTWARE) LTD

180 Tottenham Court Road, London W1P 9LE Phone 071-436 9481 FAX 071-436 0524

Smalltalk/V is a registered trademark of Digitalk, Inc. Other product names are trademarks or registered trademarks of their respective holders

CIRCLE NO. 539

Instant GUI

XVT Inc has released XVT-Design V1.0, an interactive design tool that lets the developer create the visual side of a GUI without having to resort to hard-coding in a high-level language.

XVT-Design works in conjunction with the XVT GUI library to enable the development of platform-independent GUI applications on Macintosh, Microsoft Windows, Presentation Manager, Open Look, and OSF/Motif systems. Using XVT's Universal Resource Language, resources generated with XVT-Design on one platform can be loaded onto any other XVT platform.

XVT-Design lets the developer set up menus and 'draw' controls onto a window or a dialog box. Default 'File' and 'Edit' menus are provided. Unlike a resource editor, once the GUI has been created, XVT-Design will generate a framework C program, including header files and a makefile. The MS-Windows/Mac versions of XVT-Design cost £595 each. XVT-Design is distributed in the UK by Personal Workstations on 071 231 0333.

DIY FoxPro

Ohio-based Fox Software has begun shipping its Library Construction Kit (LCK) for FoxPro 2.0.

The package provides tools to create external libraries of C and assembler routines that can be integrated into FoxPro in its interactive, application or executable forms. A cut-down version of Watcom C V8.5 is included in the pack. This was necessary because FoxPro itself is written in Watcom C. There is also a deal whereby purchasers of the LCK can upgrade to a full Watcom C V8.5 package which in-

cludes Watcom's debugger, profiler, protected-mode compiler and linker, graphics library, Windows and OS/2 versions of the C run-time library, floating-point Emulator, MAKE utility, object code librarian and additional documentation.

The company has also incorporated support for Novell NetWare's Transaction Tracking System into V2.0 of FoxPro/LAN, its LAN-based version of FoxPro. This is in conjunction with a new pricing structure aimed at capturing a larger share of the xBASE market.

FoxPro/LAN 2.0 now retails for £795 for six concurrent users on one server. The Library Construction Kit costs £345. Contact Fox Software in the UK on 0462 421999 for more details.

Micro Wars

The battle for supremacy in the hotly contested 386/486 market has taken a new turn. Both Intel and AMD have launched new 386 microprocessors.

Intel has announced a cheaper version of the Intel386 SL. This 20MHz cache-less microprocessor is targeted at the portable PC market and offers on chip power management.

AMD has introduced a number of revved-up devices including a 33MHz Am386SXL and a 40MHz Am386DXL microprocessor. AMD is also planning an offensive on Intel's monopoly of the 486 arena later this year. The Am486DX will be available in 25, 33 and 50 MHz versions and will offer reduced power consumption. There will also be a 25 MHz Am486SX.

Intel's 20 MHz Intel386 SL costs £60. The 33 MHz Am386SXL costs £76 (=£42) and the 40 MHz Am386DXL costs \$114 (=£63).

Intel can be reached on 0793 696000. AMD is on 0483 740440.

New from SCO

The Santa Cruz Operation (SCO) has been busy upgrading its product line. SCO UNIX SVR3.2 V4.0 is the latest release of the popular UNIX operating system for 386/486 machines. The new version can be obtained on CD-ROM and includes SCO Shell (a menu-driven user interface to the UNIX system) and provides support for loadable device drivers. It is now able to access up to 512 MB of RAM and can cope with disk drives larger than 1.2 GB. The V4.0 development system features new tools, updated libraries and certified compliance with the POSIX and XPG3 standards, along with compliance with Issue 2 of the Intel Binary Compatibility Specification (IBCS-2).

SCO UNIX MPX Release 2.0 is a new version of SCO's Multi-processor Extensions to the SCO UNIX operating system. MPX works in conjunction with SCO UNIX or SCO Open Desktop. In a multi-processor system, with UNIX running on the first processor, each copy of MPX enables another processor to share the overall workload of the system. MPX now supports hardware from several vendors including ALR, Compaq, NEC and Olivetti.

SCO UNIX V4.0 is available on diskette, tape and CD-ROM media at £495 for a two-user licence and £995 for an unlimited-user version. The development system costs £995. SCO MPX Release 2.0 is priced at £1,195. The Santa Cruz Operation can be contacted on 0923 816344.

AI in a box

Integral Solutions' PopLog, the program development environment, is now available for UNIX-based PCs. The PopLog toolkit integrates Prolog, Lisp and Pop-11. The toolkit includes PopLog Rules (for automatically generating expert-system rules), PopLog-Neural (an interactive Neural Network design tool) and PopLog-Flex (an expert system toolkit). PopLog costs £4,500. Integral Solutions Ltd is on 0256 822028.

Network Solutions

Novell is now offering a 5 and a 50 user version of the Netware V3.11 network operating system. Netware V3.11 incorporates 32-bit multi-tasking and supports DOS, Windows, Macintosh, OS/2 and UNIX platforms. Disk duplexing, read-after-write verification and disk mirroring are also provided. The prices of the 5 and 50 user versions of Netware V3.11 are £800 and £3700 respectively. Novell can be reached on 0344 860400.

Real Time C

The JMIC Executive real time kernel now supports MetaWare's C compiler and PharLap's assembler and linker for the 80386. This latest version (C Executive V2.4A) provides device and I/O drivers for a 386 PC motherboard. A system debugger, CE-View, is also available. The developer's version of C executive costs £1500. CE-DOSfile is priced at £750 and the CE-View debugger costs £300. C Executive is distributed in the UK by RTS on 0624 623841.

ISO Graphics for PCs

Developers using the Zortech C/C++ compiler family can now write device independent graphics applications using S-GKS V3.0, a new implementation of the ISO certified Graphics Kernel System (GKS) called S-GKS V3.0. S-GKS has many advantages over standard DOS graphics libraries and it enables developers to write graphics applications which are source code compatible over several platforms including UNIX and VAX/VMS. S-GKS costs £325. For more information contact Scientific Software Ltd on 0628 890011.

Glock on AIX

Dublin-based Glockenspiel is planning to publish the first open C++ toolset for the new IBM AIX Software Development Environment Workbench/6000. Glock C++ 3.0 is a preprocessor based on AT&T's C++ V3.0. The company is also working on a C++ 3.0 compiler for OS/2 2.0. C++ 3.0 on AIX will cost about £1,500. Glockenspiel is on 010 353 1733166.

Letters

We welcome short letters on any subject that is relevant to software development. Please write to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. Unless your letter is marked 'Not for Publication', it will be considered for inclusion in this section.

VR, a Panacea?

Sir,

As the real world gets more hazardous and unpleasant in the craze to travel further and faster each year, so the benefits of spending at least part of our lives in fantasy have an increasing appeal. So I enjoyed your articles in the December issue and was led to speculate on a new solution to one of my pet problems. Could VR help delay the time when our assault on the environment stifles us all in noise and poisonous fumes?

Could the programming industry come to the rescue with VR packages to allow would-be Porsche owners to simulate the antisocial features of their craving by acting out their fantasies in a safe and environmentally friendly manner? How about a really green Golf GTI comprising a bog standard box with a 1300cc engine for the essential journeys and a VR kit, for use only in the home, to satisfy that urge to drive faster and more noisily than everyone else?

Of course usage of the real and virtual kit must be mutually exclusive, and I can see the need to simulate some virtual spectators, perhaps a passenger or two... otherwise what would be the point? Could VR trendies be persuaded to display stickers on their back windows 'My VR car's a Bugatti' instead of the engine size and performance badges we see on the backs of so many cars today? Apart from the savings in cash, energy and lives, no more incentive to steal cars and race them around the streets when we drive nothing more powerful than a Ford Pop or Metro.

The possibilities are endless. Rush hours could become distant memories when we do our virtual work in virtual offices, and that Mr VR, what a nice boss, pleasure to do his bidding, (shame about the pay!). And just think how much slimmer we would be with virtual meals, more delicious than any mother made.

So go to it programmers! Britain may have lost out in designing and building real products but there is a whole virtual world out there where we can show how environmentally friendly we are! No more whinging about a solution looking for a problem!

Terry Smith
Leeds

Borland's secret bug-list?

Sir,

Being a relatively experienced C++ user, I was more than interested in the new Borland C++ compiler (V3.0) as reviewed in your December '91 issue. I am currently involved in a large ongoing client-server project using C++ on a Windows 3 platform, and our current compiler is Borland C++ V2.0. We upgraded to Borland 3.0 immediately, being keen to enjoy the extra features (such as a DPMI compliant tool set) and development tools included. As you may expect, we did some preliminary testing of the new compiler before unleashing it on the entire project. During this we found three obvious bugs in the package, which we believe should have been caught at 'alpha test' stage (these are not to be confused with the incompatibilities between Windows 3.1 and the IDE and other tools). The bugs range in seriousness from 'cosmetic' to 'very serious'. They are:

The Windows debugger does not return the correct termination code of a program (Borland tells me that it gets confused about the stack),

return statements in in-line constructors are flagged as syntax errors despite being perfectly valid syntax (and good practice some would say),

return statements in destructors trigger a bug in code generation, whereby base class destructors don't get called, so objects are not fully 'destructed'.

The first two bugs can be considered annoying, but cause no major problems.

The third bug however is subtle and causes serious problems. No warnings are generated, and programs with the fault generally do not die immediately, they just fail to clean up certain objects properly. The overall impression is of a lack of thorough testing, of a product rushed to market to appear before the release of Microsoft C 7.0.

Borland Technical Support has now acknowledged these as bugs (after I sent them very small programs to demonstrate the bugs), and says that they will be fixed in future releases of the compiler. The problem that I have is that Borland will not tell me of any other serious compiler bugs, they will not ship a fixed version of the compiler (they say it may take six months), and they even denied that my test programs were valid C++ syntax until I quoted to them chapter and verse of *Ellis & Stroustrup*. I am left with a compiler with some known bugs, which should have been caught a long time before the product hit the shelves, and a suspicion that many more bugs may have slipped through the apparently inadequate testing, and which Borland may be aware of but won't admit to.

I am sending this letter to bring these bugs to the attention of any other users of this compiler, and in the hope that they will in turn tell others of any bugs that they find. Borland says that they will not release bug lists 'because no other PC software makers do'. Well, every copy of Zortech C++ contains a list of known bugs, and those recently fixed. Microsoft has been known (on demand) to release bug lists, as has Lotus. Until such time as software manufacturers show the maturity to release lists of known and serious bugs regularly, especially in development tools such as compilers, PC development will still be seen as a 'toy environment' compared to the open nature of serious and more stable worlds of UNIX *et al.*

Tim Meadowcroft
Cambridge

Zortech lib revisited

Sir,

In .EXE March 1991, I wrote a review of the Zortech Database Library which was not exactly complimentary.

In reviewing a new product, it is inevitable that first impressions tend to skew the balance, particularly where there are highly visible user-interface glitches.

Just as I am sure that writers of OSs receive few compliments, perhaps the best a database designer can hope for is that nobody notices it's there. For the record, I feel I should point out that since writing the review I have used the Zortech Database Library in two substantial applications and have found it to run flawlessly.

Finally, I haven't liked recent .EXE covers - it's getting to look more and more like a comic book. Maybe it doesn't matter because the magazine is not for retail sale, but I do on occasion point out articles to clients. I would urge you to go for a more professional look without selling out to the men in grey suits.

John Cant
PHD Computer Consultants
Edinburgh

Mr Cant is to be praised for coming forward with his revised opinion. Let this be an awful warning to all .EXE's contributors, as well as its Editor, of the danger of shallow reviews. The problem is, of course, that it is dangerous printing a review based on five months' heavy use of a package as a) you the readers are not all prepared to wait that long, and will attempt to find the info elsewhere and b) the actual product will have itself been superseded. However, the issue is not straightforward. Should we be printing more (or only) 'long term' reviews, as favoured by some other magazines? Your comments welcome.

Meanwhile, apologies are clearly due to Zortech in general and in particular to Steve Teale, who is the author of the Zortech database.

As for the .EXE's covers, perhaps Mr Cant has found the current offering and its predecessor more to his taste - Ed.

Bombed

Sir,

In the Security Supplement to February's .EXE Magazine, I presented an algorithm for defending against viruses. This consisted of a series of tests on the files as well as some simple tests on the system itself.

It turns out that some clones of MS-DOS (and even MS-DOS V5.0) can exhibit behaviour that would, under the circumstances described in my article, be considered suspicious. MS-DOS V5.0, for example, will

map memory one paragraph short of the 640 KB limit when DOS=HIGH,UMB is set in CONFIG.SYS, and some DOS clones can map memory to as much as 1 KB short of the end of BIOS memory. Digital Research DOS (DR-DOS) V6.0 will load interrupts into the 64 KB above the Intel 1 Megabyte limit in 286 or better machines and use a JMP FAR instruction to access them.

Accordingly, I have enclosed updated files SYSCHECK.C and DOSMCB.C to account for these possibilities and have sent you Stealth Bomber version 2.2 to replace version 2.0 for distribution. Special thanks to Mark Hamilton for his time and expertise.

Kevin Dean

Toronto, Canada

We only sent out about four disks, all before Feb 6th, with the faulty version of STEALTH.

If you were one of the recipients of these disks (you can tell because there is no mention of the update in the README.1ST file) please call the Editorial Office and we will mail you the corrected version. We'd like to echo Kevin's thanks to Mark Hamilton for his considerable help in this matter - Ed.

Letter of the Month

The writer of the best letter of the month, as judged by the Editor, will be receive a £20 book voucher, courtesy of Just Computer Books. The best letter is the one printed first. Please note that letters submitted to this page may be edited.

Put an end to software piracy!

Meet the growing family of security keys from Software Security.

Each one a specialist at enforcing your license agreement in virtually any user environment you can think of. Whether it's DOS, UNIX, Macintosh or OS/2...whether it's a single user installation or a LAN.

Simply connect the appropriate key to a single user computer, or a non-dedicated file server in a network, and you control all access to your protected application.

Users, however, won't even know it's there. The keys are transparent and won't impact software functionality or the ability to make back up copies. Normal node and LAN operations are unaffected.

Simple. Unassuming. Ever vigilant. Easy to incorporate into your application package. And quite possibly the most profitable hardware investment a software developer can make.

To find out more, call: (0784) 430060

fax: (0784) 430050

International telephone: +44 784 430060

fax: +44 784 430050



Software
Security
International Ltd

21a The Precinct
High Street
Egham
Surrey
United Kingdom
TW20 9HN

CIRCLE NO. 540

THE ULTIMATE PROTECTION FOR SOFTWARE PUBLISHERS



All product names are trademarks or registered trademarks of their respective holders.

'Twixt Host and Target

The design of embedded system debuggers has, so far, been at the whim of the writer. A new interface standard will benefit both manufacturers and users, says Daniel Mann.

Code development for an embedded processor is generally more costly than development of code of equivalent complexity intended for execution on a 'general purpose' machine, such as a workstation. The embedded application code cannot benefit from an underlying support operating system such as UNIX. In some cases, developers may choose to first install a small debug support monitor or third-party executive which can offer a somewhat improved development environment. In the process of getting an embedded support monitor running or developing application code to run directly on the processor, emulation hardware may be employed. The availability of debug tools, and the extent to which it is possible to configure them, are important factors when selecting a processor for an embedded project.

The architecture of the latest RISC processors may be simplified compared to their

CISC predecessors, but the complexity of controlling the processor operation has not been reduced. The use of register stacks and instruction delay slots and other performance enhancing techniques has lead to increased use of high-level programming languages such as C. The compiler has been given the responsibility of producing efficient assembly code, and the developer rarely deals with code which manipulates data at the processor register level. The increased productivity achievable by this approach is dependent on high-level debug support tools.

Developers of products containing embedded processors are looking to RISC for future products offering increased capability. The greater performance relative to RISC processor cost should make this possible. The suitability, cost and productivity of the tools available for code development are likely to be the major factor in

deciding the direction ahead in preparing to tool-up for RISC.

This article describes a Universal Debug Interface (UDI) which is processor independent and enables greater debug tool configurability. A number of emulator and embedded monitor suppliers as well as high-level language debug tools suppliers are currently configuring their tools to comply with the proposed UDI standard. Current implementations are targeted for RISC processor code development. UDI should ease the choice in selecting tools and consequently selecting RISC. I shall concentrate on describing the Free Software Foundation's GDB C language source debugger's integration with UDI.

Tool Developers

A debug tool developer typically arranges for his product to be available for a range of popular processors. This normally means rebuilding the tool with the knowledge required to understand the peculiarities of each processor. If an enhancement is made to the debugger user interface, then normally the debugger source and the processor specific information must be recompiled and tested before customers are updated.

When developing code to run on a workstation, the processor supporting the debugger execution is the same processor running the program being developed. This means the debugger can make use of operating system services such as `ptrace()` (described later) to examine and control the program being debugged. When developing code for an embedded application, the program being developed is known as the *Target Program*, and executes on the *Target Processor* which is usually a different processor than the one supporting the debugger, known as the *Host Processor*. The host processor and target processor do not communicate via the

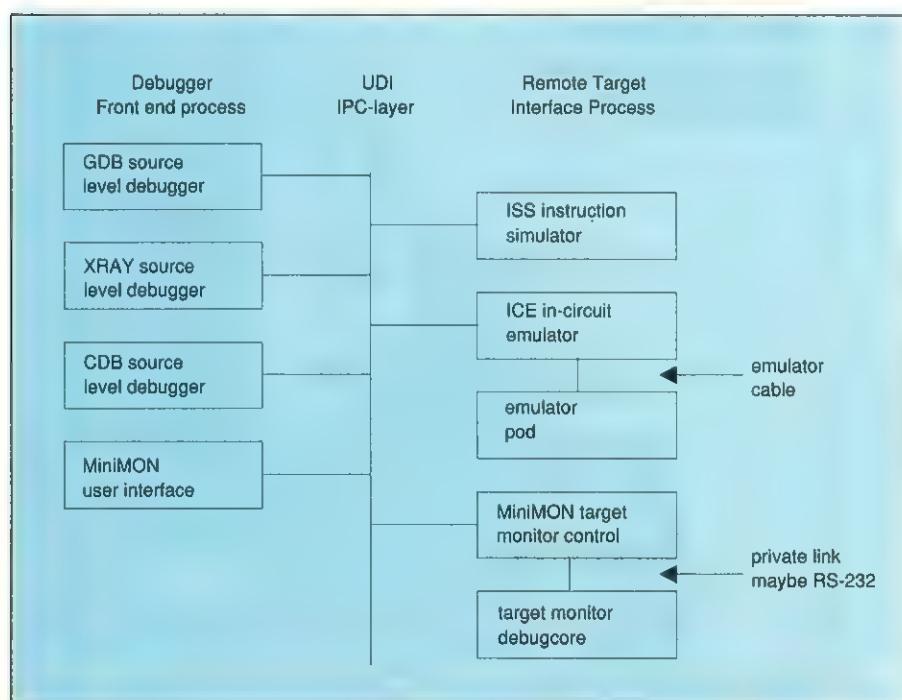
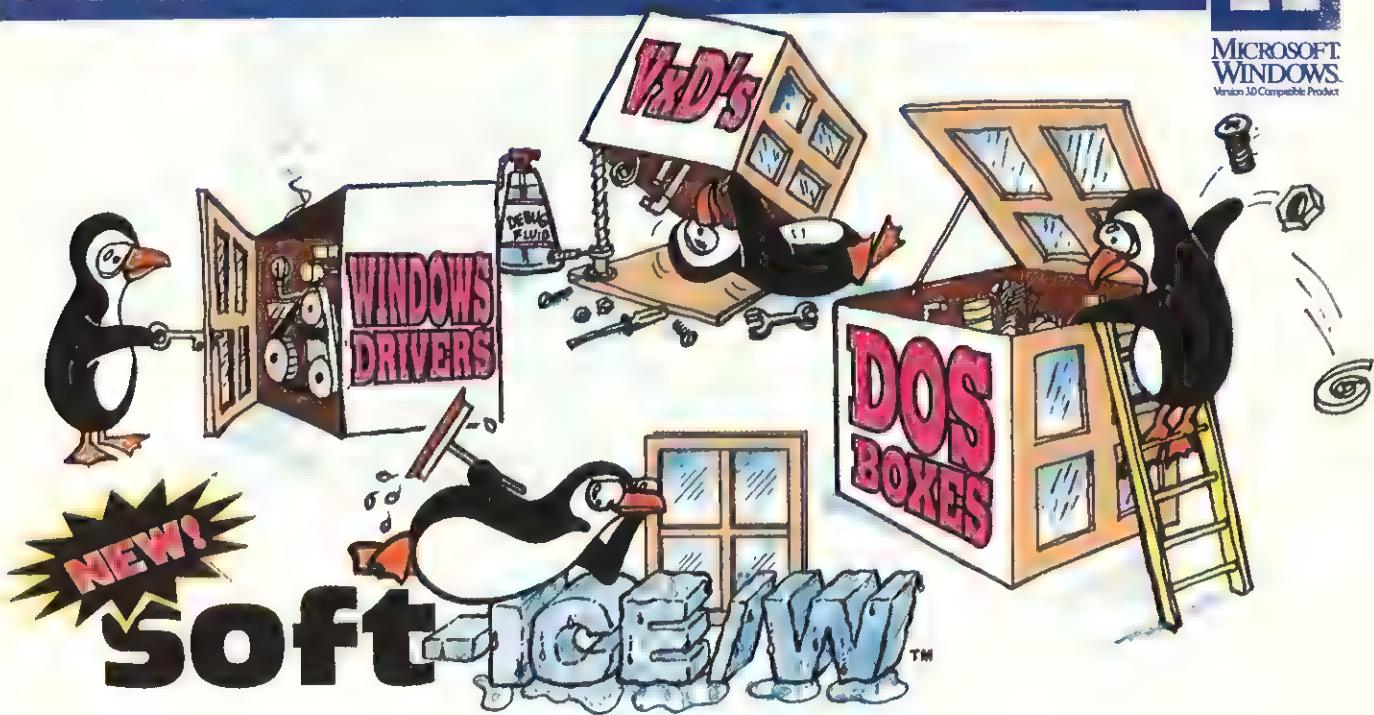


Figure 1 - Some UDI conforming debug tools

Get Inside WINDOWS!



MICROSOFT
WINDOWS.
Version 3.0 Compatible Product



Soft-ICE

Debug Windows at the systems level!

Soft-ICE/W takes you inside Windows! Debug and explore with power and flexibility not found in any other Windows debugger! Soft-ICE/W allows you to debug at the systems or applications level or simply learn the inner workings of Windows.

- Debug VxD's, drivers and interrupt routines at source level
- Debug interactions between DOS T&SR's and Windows Apps
- Debug programs in DOS boxes
- Display valuable system information
(from the total memory occupied by a Windows application, to the complex internal structures of Windows)

Soft-ICE/W uses the 386/486 architecture to provide break point capabilities that normally require external hardware. Nu-Mega, which pioneered this technology with the introduction of its award winning Soft-ICE for DOS, now gives Windows programmers the same debugging power... and still at a software price.

Own the debugger that combines the best "view" of Windows Internals with the most powerful break points of any software debugger.

Soft-ICE/W . . . Only £259.00 +VAT

CodeView for Windows users: see what you're debugging without flash. **CV/1 version 2.0** runs CodeView in a graphics window while viewing your application screen. Runs on **any** display that supports Windows.

CV/1 . . . Only £95.00 +VAT

WHAT THE EXPERTS ARE SAYING

"Soft-ICE for Windows is great! It helped me find, in fifteen minutes, a killer bug in a Windows virtual device driver that had eluded two people for several months. I can't see doing Windows development of any kind – whether writing Windows applications, device drivers, or even DOS programs that have to run under Windows – without it. In addition to being great for finding bugs, Soft-ICE for Windows has been essential for my work on a forthcoming book: on Undocumented Windows. Soft-ICE for Windows goes anywhere and does everything, so it's essential for anyone who wants to poke around inside Windows Enhanced mode. DOS programmers will find it a perfect way to learn how the Windows DOS extender and DPMI server work, and how Windows interacts with DOS. Windows Enhanced mode is the hacker's paradise of the 90s, and Soft-ICE for Windows is the tool that every serious Windows or DOS hacker will need. Nu-Mega has done a brilliant job!"

Andrew Schulman
Software Engineer, Phar Lap Software
Editor, Undocumented DOS
Coauthor, Undocumented Windows (forthcoming)

Tel: (071) 833 1022

Fax: (071) 837 6411

3-5 Cynthia Street,
London N1 9JF

Now in the UK

**System
Science**

RISK = NULL

30 DAY
MONEY-BACK GUARANTEE

If you could create your own computer for developing software what would you build?

You'd need a system to increase your productivity, one that helped you create applications in half the time it takes you now – and complete projects ahead of schedule!

You'd want a true multitasking system with virtual memory. Because that would give you the kind of computer that will let you compile a program in one window while debugging in another, so if your new application should crash your whole system won't die.

You'd give it plenty of power and speed to handle even the most complex projects, complete with UNIX and the Motorola 68040 processor.

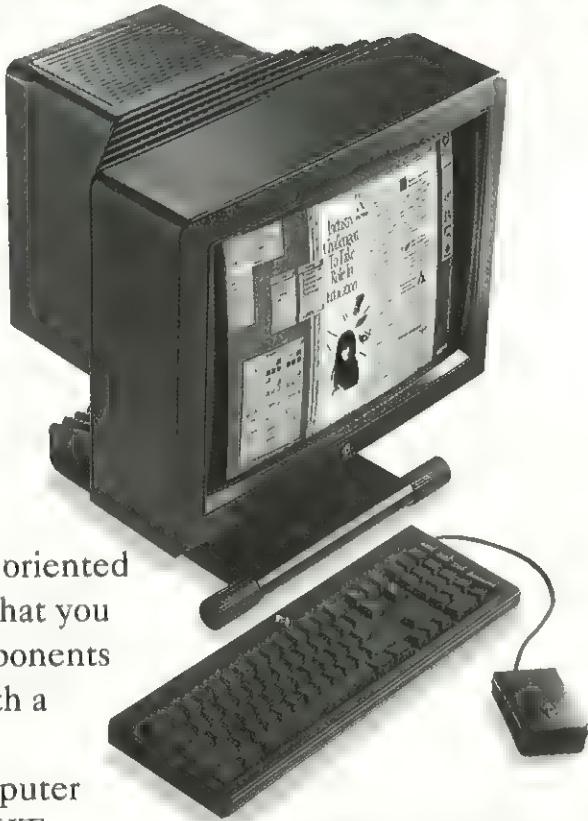
With your users in mind, you'd want an Interface Builder so you could create an outstanding user interface – quickly and easily.

And you'd want an object oriented programming environment so that you could reuse your software components and it would help if it came with a complete object library.

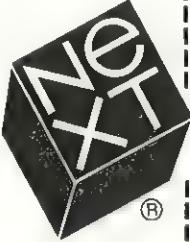
Fortunately, there's a computer that already offers this, the NeXT computer. The tools provided by the NeXTstep operating environment make it easy to develop advanced, user-oriented programs.

So take the NeXTstep and call 081-565 0005 for more information, or fill out the coupon.

THE ULTIMATE DEVELOPMENT MACHINE.



The Professional's Workstation



I'd like to receive more information on NeXT

I'd like to receive more information on NeXT Developer Courses

Please complete and return to: NeXT, 286 Bath Road, West Drayton, Middlesex UB7 0DQ.

Name: _____

Company: _____

Address: _____

County: _____

Telephone: _____

Post code: _____

```
/* Sample prototype of a UDI-p procedure */
UDIRead(
    /* source address on target */
    UDIResource from,
    /* destination address on DFE host */
    UDIHOSTMemPtr to,
    /* count of objects */
    UDICount count,
    /* size of each object */
    size_t size,
    /* count actual transferred */
    UDICount *count_done,
    /* endian conversion flag */
    UDIBool host_endian);
```

Figure 2 - UDI-p Library call

ptrace() system call, but via whatever hardware communication path links the two processors. The portion of the debugger which controls communication with the target processor is known as the target interface module, and whenever a change or addition is required in the communications mechanism, the debugger must be recompiled to produce a binary executable which is specific to the target-processor and target-communications requirements.

When the chipmakers turn out their latest whiz-bang RISC processor, the tool developer companies are faced with considerable development costs in ensuring their tools function with the new architecture. It is not uncommon for the availability of debug tools to lag a long way behind RISC chip introduction. Often tools are introduced with limited configuration options. For example, target processor communication may be according to a low-level debug monitor protocol, or an in-circuit emulator (ICE) protocol. Each debugger product has its own target interface module, this module must be developed for each debugger which wishes to communicate with the new target RISC processor.

An embedded application developer may have prior experience or a preference for a particular debug tool, but the only available communications path to the target may not be currently supported. This incompatibility may discourage the developer from choosing to use a new processor. It is therefore desirable that debuggers share communication modules and be more adaptable to available target processor interfaces.

Ideally a debugger from one company should be able to operate with, say, an emulator from another company. This would make it possible for a customer to select a little used debugger with a popular target monitor or vice versa.

The goal of the Universal Debug Interface (UDI) is to provide a standard interface

between the debugger developer and the target communications module, so the two can be developed and supplied separately. In fact, an applications developer could construct his own communications module, for some special hardware communications link, as long as it complied with the standard.

UDI

If UDI were a specification at procedural level, then debugger developers and communication module developers would have to supply linkable images of their code, so the debug tool combination could be linked by the intended user. This is very undesirable because it would require a linked image for every tool combination. Additionally, the final linked program would be required to run on a single debug host. UDI actually relies on an inter-process communication (IPC) mechanism to connect two different processes. The debugger is linked into an executable program to run on the host processor - this process is known as the Debugger Front End (DFE). The communications module is linked as a separate process which runs on

the same or a different host processor, and this process is known as the Target Interface Process (TIP). The two processes communicate via the UDI inter-process communication specification.

Two IPC mechanisms have so far been specified; one uses shared memory and is intended for DOS developers, the second uses sockets and is intended for UNIX and VMS developers. Of course, when the shared memory IPC implementation is used, the DFE and TIP processes must both execute on the same host processor. Using sockets with Internet domain communication enables the DFE and TIP to each execute on separate hosts on a computer network. Thus an applications developer can, from the workstation on his desk, debug a target processor which is connected to a network node located in a remote hardware lab. Using sockets with UNIX domain addresses (the method used to implement UNIX pipes) enables both processes to run on the same host.

Some of the currently available UDI conforming debug tools are presented in Figure 1. The inter-process communications layer defined by UDI enables the applications developer to select any front end tool (DFE) with any of the target control tools (TIP).

Because developers of UDI conforming tools must each have code which interfaces with the IPC mechanism according to the UDI protocol, the UDI community freely shares a library of code known as the UDI-p library. This code presents a procedural layer which hides the IPC implementation.

Consider the following example UDI-p call given in Figure 2. The DFE code calls the UDIRead function which *transports* the

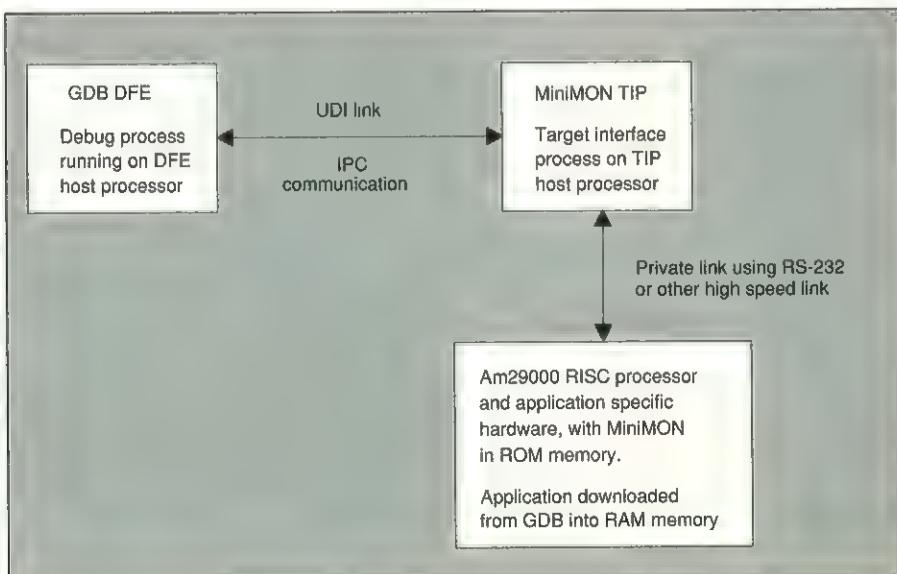


Figure 3 -Architecture of MiniMON

function call to the TIP process. The TIP code developer must resolve the function request, by adding code which is specific to controlling the particular target. The IPC layer is effectively transparent, the TIP developer is unaware that the procedure caller is from a different process, possibly on a different host machine. Figure 4 lists most of the UDI-p procedures available.

Because the DFE and TIP processes may be running on different machines, care must be taken when moving data objects between hosts. An `int` sized object on the DFE supporting machine may be a different size from an `int` on the TIP supporting machine. Further, the machines may be of different endian. The UDI-p procedures make use of a machine independent data description technique similar to the XDR library available with UNIX. Data is converted into a universal data representation (UDR) format before being transferred via sockets. On being received, the data is converted from UDR format into data structures which are appropriate for the receiving machine. The UDI-p procedures keep the UDR activity hidden from the UDI user.

I will now discuss, in more detail, the development of a UDI conforming GDB, a source level debugger from the Free Software Foundation. GDB is an example of a DFE process. As an example of a TIP process, we shall look at the MiniMON monitor for the Am29000 RISC processor. Most users of GDB will have some knowledge of the `ptrace()` system call which enables GDB to examine the state of the process being debugged. A brief description of `ptrace()` is useful, along with further explanation of its unsuitability for embedded application software development.

GDB to UDI

`ptrace()` is a UNIX system call which provides a means by which a process may control the execution of another process executing on the same processor. The process being debugged is said to be *traced*. However, this does not mean that the execution path of a process is recorded in a *trace buffer* as is the case with many processor emulators. Debugging with `ptrace()` relies on the use of instruction breakpoints and other hardware or processor generated signals causing execution to stop.

`ptrace(request, pid, addr, data)`

The interpretation of the arguments depends on the `request` argument. Generally, `pid` is the process ID of the traced process. A process being debugged be-

haves normally until it encounters some signal, whether internally (processor) generated like an illegal instruction exception, or externally generated like an interrupt. The traced process then enters a stopped state and the tracing process is notified using the `wait()` system call.

The goal of UDI is to provide a standard interface between the debugger developer and the target communications module

When the traced process is in the stopped state, its core image can be examined and modified using the `ptrace()` service. If desired, another `ptrace()` request can then cause the traced process either to terminate or to continue. Figure 5 outlines the `ptrace()` request services available.

In an embedded system, the user-interface process, which controls the debugging, and the application process, which is being debugged, may not be executing on the same processor. So it is not possible to use the `ptrace` system call mechanism to debug embedded application software. The debugger process (DFE) must run on a separate processor and communicate with the

processor supporting execution of the application code.

The Free Software Foundation's source level debugger, GDB, by default makes use of the `ptrace` system call. However, it can alternatively use a collection of procedures which support communication to a remote processor. These procedures implement the necessary protocols to control the hardware connecting the remote processor to the host debug processor. By this means, GDB can be used to debug embedded application software running on application-specific hardware.

Newer versions of GDB (version 3.98 and on) implement the procedural interface to a remote target processor via procedure pointers which are members of a `target_ops` structure. The procedures currently available are listed in Figure 6. According to GDB configuration convention, the file `remote-udi.c` must be used to implement the remote interface procedures. In the case of interfacing to the IPC mechanism used by UDI, the procedures in Figure 5 are mapped into the UDI-p procedures given in Figure 4. With the availability of the UDI-p library it is a simple task to map the GDB remote interface procedures for socket communication with a remote target processor.

UDI to MiniMON

AMD's MiniMON is an example of the kind of software required at the business end of the setup. MiniMON is not intended to be a stand-alone monitor - it requires the support of a software module - the target interface process (TIP) - located in a support processor. The Am29000 target processor communicates with the processor running

| Procedure | Operation |
|-------------------------|---|
| UDIConnect | Connect to selected TIP |
| UDIDisconnect | Disconnect from TIP |
| UDISetCurrentConnection | For multiple TIP selection |
| UDICapabilities | Obtain DFE and TIP capability info. |
| UDIEnumerateTIPs | List Multiple TIPs available |
| UDICreateProcess | Load a program for debugging |
| UDISetCurrentProcess | Select from multiple loaded programs |
| UDIDestroyProcess | Discontinue program debugging |
| UDIInitializeProcess | Prepare run-time environment |
| UDIRead | Read data to target processor memory |
| UDIWrite | Write data to target processor memory |
| UDICopy | Duplicate a block of data in target memory. |
| UDIExecute | Start/continue target processor execution |
| UDIStep | Execute the next instruction |
| UDIStop | Request the target to stop execution |
| UDIWait | Inquire about target status. |
| UDISetBreakpoint | Insert a breakpoint |
| UDIQueryBreakpoint | Inquire about breakpoint |
| UDIClearBreakpoint | Remove breakpoint |

Figure 4 - Principle UDI-p procedures

LEARN THE POWER OF FOXPRO 2.0 IN 5 DAYS FLAT

FoxPro 2.0 is here - and with it, the ability to process information at unheard of speeds.

Now you can see how to design, build and manage systems which do full justice to the power of the new product - with F1 training courses.

As beta-testers for FoxPro 2.0 - and a major developer of commercial database applications - no-one is better qualified to train you than F1.

5 DAY INTENSIVE COURSE

A single course which trains you in all elements of FoxPro 2.0 - five days later you can design and develop a multi-user system from start to finish.

Includes: • Database design • Program design • Program implementation • Debugging • Project management • Documentation • Reports • Screens • Menus • Mouse and window object-oriented programming • Use of Rushmore • Performance tuning • Network problem solving... and more.

COURSES FROM 1 - 4 DAYS

F1 tailors other database courses to suit the needs of specific users. These courses range from one to four days, and provide a complete skills package.

• For New Users: 2 one-day courses • For Intermediate Users: 2 day course • For Advanced Users: 4 one-day courses. A detailed breakdown of all these courses is available from F1.

BOOK NOW

All courses are held at F1's training facilities in Bath or London, working in small groups of 4-6, for the highest standards of personal tuition. Call Kevin Edwards now on (0225) 427285, for course dates and booking information.



CIRCLE NO. 543

Blast! The 640K DOS barrier...

Let's face it. Today's average PC sports at least 1 meg of RAM, often more. So it's natural that your programs should be able to make the most of the many benefits of Extended Memory. Bring on the dynamite - the TopSpeed DOS Extender Toolkit. Not only does it give you an extended development environment, it also gives you a powerful toolkit to produce DOS programs that can make full use of extended memory.

- Provides 512 Mb virtual address space
- Full range of DOS calls
- OS/2 family API
- Supports XMS, DPMI, and VCPI
- Comprehensive porting guide
- Multi-threading and DLL support
- Supports C++, C, Pascal and Modula-2
- Royalty free distribution

For a detailed information pack on the TopSpeed DOS Extender and other TopSpeed languages call us now on 0234 267500.

Much existing code can be ported to the TopSpeed DOS Extended Environment without re-coding. The TopSpeed DOS Extender Toolkit supports TopSpeed C++, C, Modula-2 and Pascal and requires a 286 processor or better.

TopSpeed products are available in the UK from Grey Matter 0364-53499, System Science 071-833-1022, The Software Construction Company 0763-244114 and other leading software tool vendors.

**JPI, The Mansards, Tavistock Street,
Bedford, MK40 2RX**
Tel: 0234-267500. Fax: 0234-217094

* Special pricing for existing users

Blast the 640K DOS barrier with TopSpeed

CIRCLE NO. 544

the TIP process via a serial link or other higher performance channel. This link supports a message system which is 'private' to the MiniMON monitor, by which I mean that it is completely independent of the UDI protocol. See Figure 3.

Developers of software for embedded applications are used to working with emulators. They enable code to be downloaded to application memory or installed in substitute overlay memory. This avoids having the development delays associated with running code from EPROM. Emulators may be indispensable in the early stages of getting the target hardware functional. However, once the processor is able to execute out of target system memory and a communications channel such as a serial link is available, the need for an emulator is reduced. Emulators are expensive, and it is not always possible to make one available to each team member. The use of a debug monitor such as MiniMON during the software debug stage of a project is an economical alternative to an emulator.

MiniMON must be installed in target system ROM memory or downloaded by the host via a shared memory interface. The target application code and additional operating system code can then be downloaded via the message system. If changes to the code are required, then the message system can be used to download new code quickly without changing any ROM devices.

Most monitors do not offer high-level language support. Debugging takes place at the level of assembly code instructions rather than the original, say C, code. Using GDB in conjunction with MiniMON enables source level code to be debugged, which is far more productive and necessary for large software projects.

Summary

A number of debug tool developers are currently or will be shortly offering tools

| Request | Operation |
|------------|---|
| TraceMe | Declare that the process is to be traced |
| PeekText | Read one word in process's instruction space |
| PeekData | Read one word in process's data space |
| PeekUser | Examine the process control data structure |
| PokeText | Write one word in process's instruction space |
| PokeData | Write one word in process's data space |
| PokeUser | Write to the process control data structure |
| Cont | Start-up process execution |
| Kill | Terminate the process being debugged |
| SingleStep | Execute the next instruction |
| GetRegs | Read processor registers |
| SetRegs | Write processor registers |
| ReadText | Read data from process's instruction space |
| ReadData | Read data from process's data space |
| WriteText | Write data into process's instruction space |
| WriteData | Write data into process's data space |
| SysCall | Continue execution until a system call |

Figure 5 - The *ptrace()* request services

which are UDI compliant. Typically the DFEs are C source level debuggers. This is not surprising, as the increased use of RISC processor designs has resulted in a corresponding increase in software complexity. The use of a high-level language such as C is more productive than developing code at machine instruction level. And further, the use of C enables much greater portability of code among current and future projects. The low cost of GDB makes it an attractive choice for developers.

Target processors and their control mechanisms are much more varied than DFEs. I have briefly described the MiniMON TIP, which is a process which controls the execution of an Am29000 processor. A small amount of code known as the *debugcore* is placed in target processor ROM memory and enables examination of the processor state. The MiniMON TIP communicates with the debugcore via a hardware link which is specific to the embedded application hardware.

Other TIPs already exist and are under development. I know of an Am29000 simulator (ISS) which runs on UNIX hosts. The DFE communicating with the simulator TIP

is unaware that the Am29000 processor is not present, but being simulated by a process, executing on, say, a UNIX workstation. There are also tool developers constructing TIP programs to control processor emulators. This will make possible a top-of-the-line debug environment.

Because debuggers like GDB are available in source form, developers can add additional debug commands, such as examination of real-time operating system (OS) performance. This would require adding OS structural information into GDB. When the debugger front end and, for example, emulator interface module are supplied as a single executable, adding new commands is not possible. Via the use of Internet sockets the debugger may execute on a different networked host than the node supporting the emulator control process.

UDI makes possible a wider tool choice for application code developers. Debugger front end tools are supplied separately from target control programs. The user can consider cost, availability and functionality when selecting the debug environment. Never before has this level of debug tool configurability been available to the embedded application development community.

EXE

Daniel Mann is senior member of the technical staff supporting the Am29000 processor at AMD in Austin, Texas. He bears an unexpected British accent, and may be contacted on 0101 512 462 4872, or via Email as daniel.mann@amd.com.

The XRAY Debugger Front End is produced by Microtech Research (0256 57551), the CDB Debugger Front End is produced by Third Eye Software.

Figure 6 - GDB Remote Target-Operations

Configuration Management

PVCS and PolyMake for UNIX platforms...

- DEC
- Bull
- DataGeneral
- ICL
- Motorola
- NCR
- Nixdorf
- Prime
- Siemens
- Unisys
- and others...

Readmar Systems

L I M I T E D

Tel (+44) 071 625 5255
Fax (+44) 071 624 9404

CIRCLE NO. 578

THE INSTITUTION OF ANALYSTS & PROGRAMMERS



The Institution of Analysts & Programmers represents an elite body of men and women who are leaders of the computing profession. These are people whose expertise enables them to analyse the problems of modern industry, and apply computers to their solution.

Membership of the Institution is a recognised mark of professional status. Designatory letters, which members are entitled to use, indicate their grade within the Institution, and their standing within the profession. Grading depends on age, experience and academic attainment.

Applications are welcomed from all men and women who are engaged in systems analysis or computer programming, or who are training for the profession. Enquiries may be made by letter, telephone or fax.

Telephone * Fax and Messages
081-567 2118 * 081-567 4379

The Institution of Analysts & Programmers
Charles House, 36 Culmington Road,
London W13 9NH. England

CIRCLE NO. 545

"Enough to make you a LATE DEVELOPER" . . . PC Business World July 91

Imagine a powerful integrated development environment common to whichever languages you choose, capable of supporting DOS, Windows or OS/2 development embodying the latest in OOP technology – it's called **TopSpeed** from JPI. Its modular architecture opens up new realms of choice – simply slot-in languages, source libraries, and toolkits to build a development system that meets your needs. No redundant components – what you want is what you get!

TopSpeed Environment – Multi-window editor, powerful Project system, Hypertext help (environment, all languages and library), debugger, syntax checker, menu or command line driven, EMS support, pop-up calc, plus . . . plus . . . plus . . . DOS or OS/2 £59

TopSpeed TechKit – For power programming. Supports DOS DLLs, post mortem debugging, advanced overlay manager, TopSpeed assembler, .EXE file compressor, .OBJ file disassembler. **Windows 3 resource compiler**, Windows 3 run-time libraries, plus . . . plus . . . £59

TopSpeed C++ – makes C++ lean and mean Unique to JPI – TopSpeed is the only true AT&T 2.1 C++. TopSpeed C++ gives you SmartMethod® Linking which eliminates unreferenced classes, methods and even virtual methods – a real breakthrough for OOP programming. Includes short based pointers, concurrent tasking – even with DOS, plus . . . plus . . . DOS or OS/2 £59

TopSpeed C – the standard is enhanced. The only ANSI certified C. Generates compact high quality code for DOS, OS/2 and Windows 3. Includes run-time error checking, multi-threading, mixed memory models, links to C++, Modula-2 and Pascal, plus . . . DOS or OS/2 £59

TopSpeed Modula-2 – the world leading implementation of Modula-2. This strongly typed and highly structured language includes type safe conversion between objects, OOP extensions with true multiple inheritance, virtual pointers, based pointers, links to C, C++ and Pascal, plus . . . DOS or OS/2 £59

TopSpeed Pascal – the next generation. Power-up your Pascal, convert to TopSpeed, then tune it up with the hottest compiler for DOS, Extended Dos, OS/2, or Windows. ISO 7185 conformant, Turbo to TopSpeed converter, ISO conformant arrays, dynamic strings, separate compilation units, OOP extensions plus much more . . . DOS or OS/2 £59

Library Source Kits available in all languages

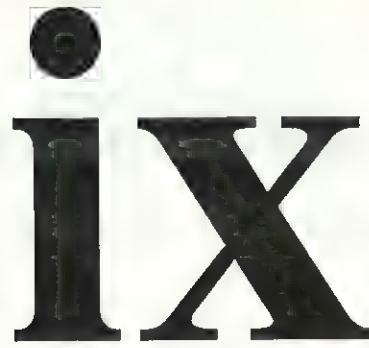
Call JPI on (0234) 267500 now for your free copy of the TopSpeed 1992 Compiler Catalogue

TopSpeed products are available from:
GreyMatter 0364-53499 • System Science 071-833-1022
RTA 081-656-7333

JPI
3 The Mansards, Tavistock Street, Bedford MK40 2RX
Fax: (0234) 217094

CIRCLE NO. 546

TopSpeed C++ **TopSpeed Modula-2** **TopSpeed Pascal** **TopSpeed C**



ix

programming editor for Windows

◆ Full Windows implementation

Cut & Paste, nearly infinite Undo, Point and Click or key strokes control all features

◆ Multiple files and windows using MDI

Load and view several files simultaneously in separate windows

◆ Folding text

Manage large object modules with sections of text 'folded' up into a single line

◆ Code documentation

Add 'post-it' style notes to any file

◆ Fully reconfigurable keyboard and menus

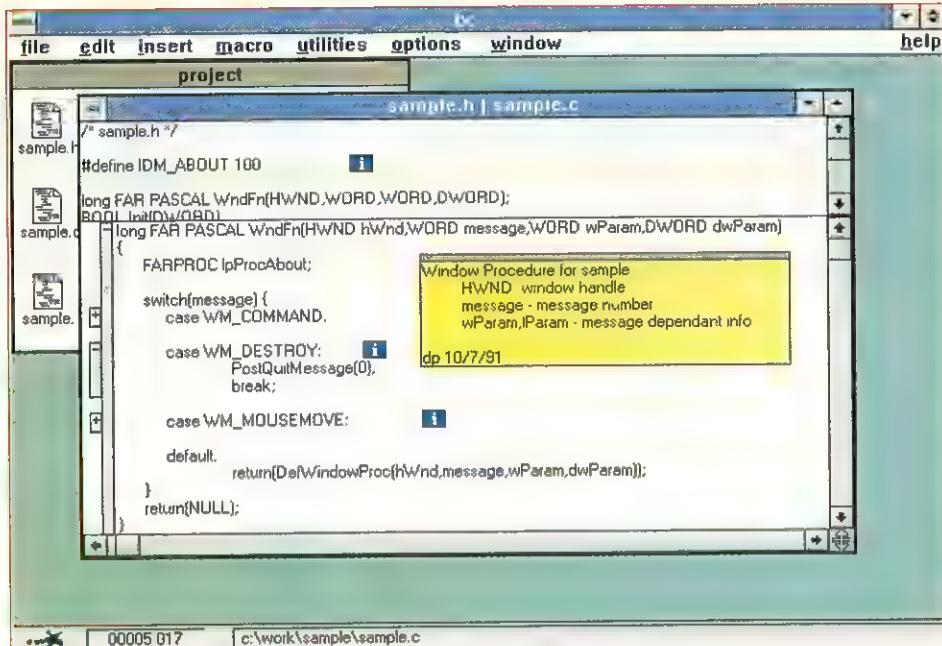
Re-assign all keys and menus, make multiple key assignments

◆ Powerful macro language built-in

Create and compile macros using any editor function with a Basic-like language

£95 + VAT

positive



As more and more users switch to Windows 3, the demand for Windows software continues to grow. Yet much of the developer's toolkit still runs under DOS. Writing for Windows has always been more complex than for DOS, and project management can be especially tricky as Windows programs tend to be made up of large numbers of files.

ix was developed to enhance programmer productivity. ix runs under Windows, and uses all the standard GUI features – MDI, split windows, cut & paste, choice of fonts and colours. It also contains several unique features which allow the developer far greater control.

With ix you can edit and test within Windows – no more switching in and out of a DOS editor. Compilation/make files can be launched from a 'Browse' window.

Browse windows help you keep track of the multiple files of a Windows project. A browser can be created for each project and used to fire up edit windows, launch resource editors (such as SDKpaint) and run programs as in Program Manager.

'Post-it' style notes can be stuck onto any source file – without modifying the file. Their names can be used to give a hypertext-like help system throughout your project.

And there's more; our AdHoc macro language, reassignable keys, custom menus and free telephone support, but we haven't got space to tell you about all that here. For more information, call or write us and we'll send you our information pack.

- positive limited •
- 22 westminster buildings •
- new york street •
- leeds ls2 7dt •
- 0532 343 104 •

A UNIX fit to embed

*UNIX is too fat, slow and complex for use in real time applications.
David Hann explains how to trim excess fat.*

UNIX is now established as the Open Systems operating platform and the move towards using UNIX has begun, or is complete, in many IT industry sectors. There is, however, one group of application developers who may well feel left out in the cold with respect to the ground swell of UNIX fever. For real time control and data acquisition applications, typical of the telecommunications, robotics and simulation industries, UNIX has no help to offer. Although the benefits of UNIX are just as appealing, there are two main problems that prevent its deployment:

- Real Time Behaviour - UNIX was designed as an interactive operating system, giving a good response to a large number of logged-in users. UNIX lacks the predictable real time response needed to safely control plant or to acquire data at high speeds.
- Stand-alone Operation - UNIX is notorious for the resources it consumes, both in terms of simple hardware (memory, disks, backup devices etc) and in terms of system administration overhead. Both of these factors make UNIX unsuitable for remote or stand-alone operation.

This article discusses the approach taken by VenturCom Inc in producing VENIX/386, a real time PC UNIX with an embedded capability for stand-alone operation.

What are they?

The term 'embedded system' encompasses a wide range of applications. Most embedded computer systems are involved in the monitoring and controlling of real world processes and systems in a full-time, dedicated fashion. Embedded systems are often required to interact with human operators and with other, higher-level information systems. A system could equally be totally unattended and in some remote location or harsh environment.

At one end of the embedded system scale, there are relatively simple applications that contain less than 100 KB of software. Clearly UNIX (or any other fully-functional OS) is inappropriate for these situations. The application simply does not justify the overhead.

At the other extreme, complex applications with sizes of more than several hundred kilobytes require full-featured operating systems. These involve advanced networking interfaces and connections, and perhaps graphical user interfaces. They use off-the-shelf third party software such as database management systems, and employ distributed control and monitoring. These types of applications continually adapt in response to evolving needs.

To many users already familiar with UNIX, the idea of shoe-horning it for use as an embedded application environment seems as absurd as it is it does impossible. UNIX systems typically require in excess of 40 MB of disk space before loading any applications, and a minimum of 4 MB of memory without X windows. For many stand-alone real time systems, this represents an unacceptable hardware cost. Furthermore, system administrators, familiar with the nuts and bolts of UNIX, must be permanently on-hand and the operating system is extremely vulnerable during power loss or hardware failure.

Despite these undoubted problems, UNIX offers a great number of benefits. These include standards, networking, user interface systems, and access to third-party off-the-shelf applications. Perhaps the biggest potential benefit is the ability to maintain a homogeneous operating environment with respect to other larger systems. Hence the primary goal for embedded UNIX, and the real reason to use UNIX in the first place, is to maintain the same basic application environment as standard UNIX. Thus developers benefit from previous UNIX

expertise, use of third party and previously developed software, and a common, powerful development and execution environments. After the application design is understood and specified, then a compact target system is configured which includes only the operating system software and utilities used by the application.

In addition to slimming down the target system, UNIX must be enhanced for acquisition and control, a robust and unattended operation. These enhancements can be done without significantly changing the application environment, except for the obvious issues such as unattended applications which cannot expect a local console for operator dialogue. Much of the following discussion is based upon the development of VenturCom's ROM and embedded VENIX/386 products.

The surgeon's knife

Even though complex embedded applications require more software and hence more memory, any superfluous memory usage drives up cost and system complexity. Most UNIX applications depend on only a handful of utilities, and many embedded applications require no utilities. Unused utilities and software are discarded, although indirect dependencies (utilities which depend upon other utilities) can complicate matters. In the best cases, this first pruning step results in a 2 MB to 4 MB file system. This residual size includes the kernel and system administration of login utilities.

Since embedded systems start application execution immediately after power-up, there is no need for login software. System administration on embedded systems is less comprehensive and simpler than on full UNIX systems. Also, standard UNIX administrative utilities are inappropriate for operators and service personnel of an embedded system, and are not designed for

unattended use. Therefore we must remove all of the standard administrative utilities, except a few for certain configurations (and, of course, those utilities called by the application). All the removed functionality is replaced by a new '/etc/init' utility, which is very compact and robust. The residual size requirement for the file system is now well below 500 KB, including the kernel and the /etc/init files.

Over 1 MB of RAM is required for the standard UNIX kernel code and data structures, such as buffer cache and page tables. By removing unused device drivers and file system types, reducing the number of buffers, and replacing a bloated console driver with a smaller cousin, we can halve the memory requirements. In some cases, applications do not use streams or require paging. By making the kernel more modular and configurable, total kernel sizes of below 300 KB are routinely achieved for a UNIX System V, R3.2 running on an 80386 machine.

Finally, tools are required to assist developers with all these configuration steps to reduce file system and RAM sizes. Based on target computer hardware configuration and a dialogue with the application developer, these tools configure and generate the kernel, include relevant utilities along with application software, and create a bootable image. Possible media for the image include floppy diskette, winchester disk, ROM devices, and network booting from a host computer.

Determinism

Monitoring and control of real world systems requires determinism. If the computer controlling a robot arm does not sense and update the arm trajectory at precisely required times, then the robot may well mangle the product it is supposed to be assembling. Although the level of determinism required varies between applications, in general the faster it is the better. Standard UNIX has unbounded worst case response times, but may be acceptable for slower applications with response times of a second or longer. UNIX with real time extensions is required for most applications.

The key factor in determinism of UNIX systems is kernel pre-emption. Pre-emption is the ability to suspend one process when an event (such as a device interrupt) occurs, and context switch to execute a higher priority process. Standard UNIX does not pre-empt while a process is executing a system call, unless the system call blocks 'waiting for I/O completion'. Since some system calls require extensive, and essentially unbounded kernel-level processing,

determinism is unbounded. Measurements show frequent cases of over 100 millisecond response times, and occasional times of over 1 second.

UNIX is notorious for the resources it consumes, both in terms of simple hardware and system administration

Adding checkpoints in the kernel (places where the kernel checks for higher priority processes) effectively bounds the worst case response time. Introducing 20-30 checkpoints at strategic locations in the kernel will produce worst case response times of 2-5 ms. Making the kernel fully pre-emptive, that is pre-empting immediately after the event, lowers the worst case response time to 200-500 µs.

Unattended Operation

After power-on or system reset, the kernel must boot and the environment must be configured and set up before the application can begin execution. Activities include determining the hardware configuration such as the presence of networks and other devices, checking switch settings, mounting data storage devices, and initialising network services. Depending on the success or failure of these activities, different steps and applications may be required. The replacement '/etc/init' utility mentioned earlier is designed to handle all of these exercises from a self-contained script, without any operator intervention.

ROM

Embedded targets of particular interest are ROM-based systems. They often represent the extreme of dedicated and robust (no disk or tape drives to fail) systems, and place serious constraints on application and operating system software. Previously, large applications or applications subject to frequent change were never placed in ROM. Today, high capacity, field reprogrammable, low cost ROM makes UNIX based applications in ROM a viable option to system developers.

The ROM of target computers is divided into two regions. The first is a small ROM (often high speed) which contains the self-test and start-up code that is executed when the computer is powered up (included in the BIOS of PCs). This start-up code loads the UNIX kernel from the second ROM region. Kernel or application code is not run directly out of this ROM because of the often slower ROM memory speeds, and because some ROM devices do not present a uniform physical address space (windowed ROM).

The kernel, which is modified to work with a read-only root file system and without paging, accesses the second ROM region as a read-only disk device containing a normal UNIX file system. In fact, the kernel is simply a file in the ROM file system. Many existing single board computers already support a bootstrap which loads an operating system from a ROM as if it was a disk.

Preparing a ROM target uses the same embedding tools and steps as embedding UNIX for disk operation (except for the use of a slightly different kernel and the additional step of 'burning' the ROM). A minimal system configured for ROM operation consists of an 80386 processor, 1 MB of RAM, 1 MB of ROM, a network connection and an interface to an instrument or device.

Conclusion

Under the guise of Open Systems, UNIX has evolved out of its initial niche in the software engineering community into the wider computing arena. Real time capabilities have taken UNIX to scientific and laboratory users, and then to the broader engineering acquisition and control markets. Now the next step of embedding UNIX systems is taking place. The feasibility of embedded UNIX has been demonstrated with the successes of the early adopters. Despite the fact that the use of embedded UNIX is still in its early stages, technical improvements in tools for embedding, system robustness and fault-tolerance, and real time, will continue to open more applications to the benefits of UNIX. The trend is clear. As embedded applications become more complex and open systems more prevalent, embedded UNIX will become the solution of choice.

EXE

David Hann is Managing Director of Real-Time Products, which distributes VENIX in the UK. He may be contacted on 021 333 6955.

PRO-C

The C Source Code

Applications Generator



100

LINES

OF CODE

PER SECOND

IMPRESSIVE?

For more information, contact the sole UK distributor

EXPOTECH (UK), Expotech House, 24 Western Road, Hove, Sussex BN3 1AF
Tel: (0273) 749222 Fax: (0273) 746446

or clip the coupon on page 23.



Don't DIY

Designers of embedded applications frequently use an in-house operating system. Microware's Stephen Montgomery makes the case for buying-in an OS.

The fundamental task of an operating system is to supervise the resources and functions of a computer. This includes providing an interface between the computer and the outside world (user), managing the system's I/O, creating and managing a file system for data storage and retrieval, managing both the system and user memory and providing a method for executing programs. As such, the term can cover a whole range of firmware for computers ranging from a small microcontroller to the largest mainframe, and so from the simplest in-house scheduler to the most sophisticated supervisory system. The most common operating systems are found on general purpose PCs and minicomputers and are very well known: MS-DOS, UNIX,

VMS, MVS etc. But systems suitable for embedded processor applications on single board computers or small subsystems are available and provide a powerful and comprehensive range of benefits to the user.

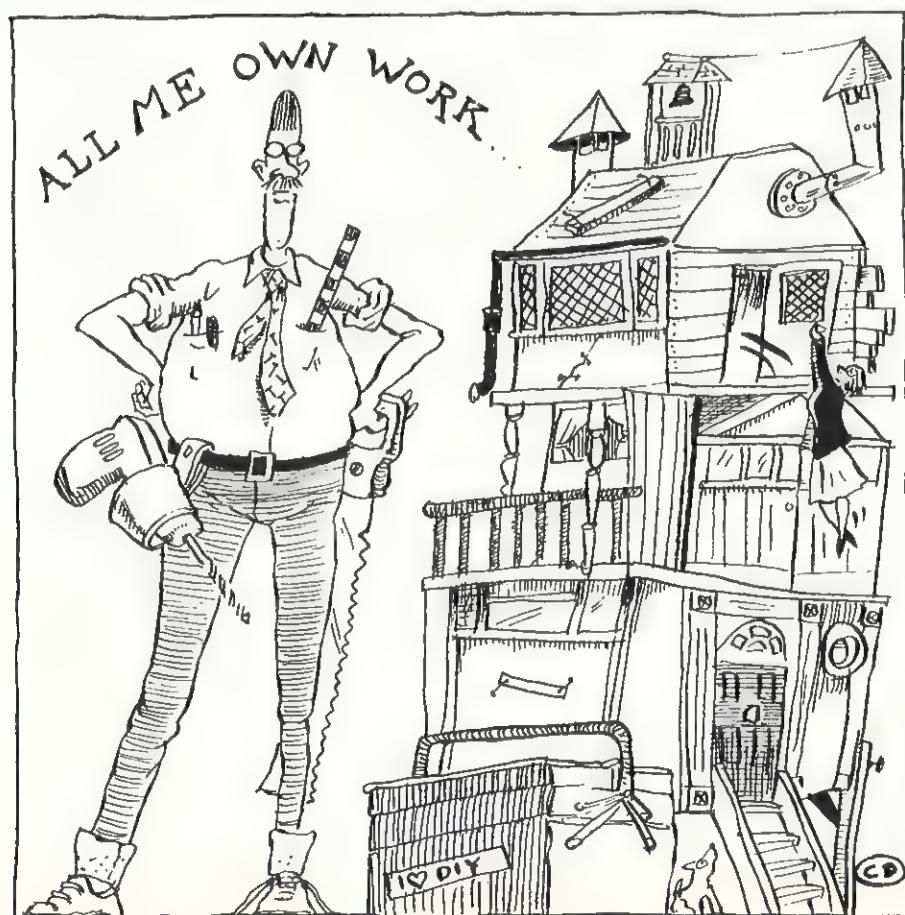
There are many of these systems available, each with its own characteristics and suitability for a particular application. Such names as C EXECUTIVE, Flexos, LynxOS, MIRAGE, PDOS, pSOS, QNX, RMX, RTOS-UH, VENIX, VMEexec, VRTX and VxWorks, not to mention Microware's own OS-9 and OS-9000, can provide attractive propositions for the designers of ever more complex and sophisticated applications, especially where real time operation is desired with multi-tasking capability.

From the earliest days, designers of embedded systems of microprocessor engineering have traditionally written their own scheduler to manage the single or multiple tasks on a processor. In many cases application complexity has increased and the scheduler has grown in complexity alongside it. Usually these in-house schedulers are written from scratch for each individual project within a company, tailored specifically for the job in hand and not written for universal application. This results in a range of different schedulers which, even with the best intentions, are unlikely to be documented extensively enough for easy system maintenance to be carried out.

The operating system, like the processor hardware itself, is something that can be bought 'off the shelf' as a standard product, allowing the development team to concentrate on the specific application rather than getting entangled in the basic system - multi-tasking, I/O management, inter-process communication, memory management. As with any proposition there are alternatives and the decision to develop or buy has to be made on a range of criteria. In this article, I hope to make you see that there are very few valid reasons why an in-house operating system is preferable to a bought-in one - at virtually any level of system complexity, performance or production level.

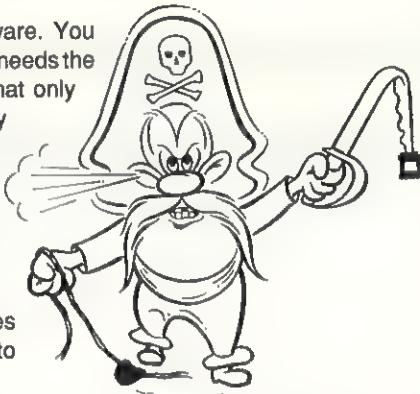
Suitability

An in-house scheduler will be characterised for the system it is designed for and will contain the features required by the system. A general purpose operating system can be selected which will cover these requirements, plus a lot more which can just be ignored (at the expense of some ROM space). However, as the application is developed and further capability added, unused features can be utilised. With an in-house system written for a specific project and defined at the very start, it is possible that the addition of enhancements may not be possible,



BEWARE THE PIRATE'S PATCH

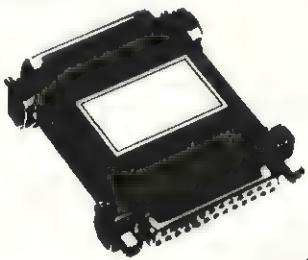
You sell your software. You don't give it away. It needs the kind of protection that only a top quality UN-PATCHABLE dongle affords, but you don't want to pay the Earth for it, and you want to be sure that you'll not be making mistakes in incorporating it into your code.



The MAXPRO system is for you. There are microprocessor based units at realistic prices which take care of complete .EXE files without access to source code. Set stop dates, tamper detection and many other facilities on a menu-driven front end. Encrypt in just moments. MAXPRO even copes with such as Clipper, QB & Clarion files with internal overlays. Neat trick.

For additional information contact us at

Brent Communications
Unit 2
Dragon Industrial Estate
Harrogate HG1 5DN
Tel: (0423) 566972
Fax: (0423) 501442



CIRCLE NO. 549

New from

Microsoft® Win32™



Application Programming Interface

The Programmer's Reference: Volume 1 & 2

The Windows 32-Bit API is an important component of Windows NT, the strategic new operating system from Microsoft. This is the pre-release information programmers have been asking for.

These two volumes contain essential information on the 32-Bit API. **Volume 1** contains overview information, the programming guide and the alphabetical API reference from A-N.

Volume 2 completes the API reference from O-Z and includes information on DDE transaction type, messages, notifications, structures, types and macros.

Volume 1
ISBN 1-55615-497-6
£34.95

Volume 2
ISBN 1-55615-498-4
£34.95

Available from most bookshops or via mail order from The PC BookShop. Tel: 071-831 0022.

CIRCLE NO. 550

LIANT C-scape® 3.2

The latest release of C-scape — the best selling character/graphics based screen interface C library in the UK. Runtime royalty free. Includes Look and Feel™ Screen Designer and Source Code. Available for DOS, most DOS Extenders, UNIX, X Windows and VMS.

DOS — £370 (incl source and LnF)
UNIX — £1065 (incl source and LnF)

OTHER LIANT PRODUCTS

| | | |
|-------------|----------------------------|-------|
| LPI C | — ANSI standard C for UNIX | £660 |
| | — ANSI standard C for DOS | £695 |
| LPI C++ | — for UNIX | £975 |
| LPI COBOL | — for UNIX | £950 |
| | — for DOS | £875 |
| LPI FORTRAN | — for UNIX | £975 |
| | — for DOS | £875 |
| LPI PASCAL | — for UNIX | £950 |
| LPI — PL/I | — for UNIX | £2200 |
| | — for DOS | £1095 |

Heron C-scape Software Extension Library



New version 2

Enhanced set of functions for C-scape 3
Includes Source Code....

Price
DOS £150
Unix £250

Phar Lap 386|DOS Extender™



Beat the 640K DOS limit with a flat 32-bit address space on 386 processors. Voted best of 1989. Supports a wide range of 32-bit languages.SDK

£330

Phar Lap 286|DOS Extender™

C beyond 640K with your Borland C++, Microsoft C or MS Fortran compiler on any 80286, 386 or 486 platform....SDK

£330

Raima Data Manager™ Release 3.21

Complete family of C library dbms functions and database management utilities for DOS, Windows, OS/2, Macintosh, UNIX, QNX, VMS. Source code available — runtime royalty free.

Single-user DOS, OS/2 or Windows DBMS object libraries....

From £460

Ask for details of other options and multi-user pricing.

MagnaCharter II

Enhanced version of the much acclaimed MagnaCharter charting package for Windows 3, 99x99 cells with wide range of printer support. Complete set of symbols — or add your own...

£160

Still available, MagnaCharter for DOS [includes runtime Windows 2.]....

£118



NEW — intelligent free text organiser and text retrieval system. Complete personal information manager or corporate information system.
DOS S/U £175 DOS M/U £625

PERSONAL ACCOUNTANT

The only complete personal finance package — for DOS £149.95
NEW — Tax Reckoner for UK tax payers — for DOS £119.95
(Personal Accountant prices include VAT).



All Systemstar products are distributed and supported by Systemstar. Prices are exclusive of VAT (except Personal Accountant) and subject to change. Orders and enquiries to:



I-3 Parliament Square, Hertford, SG14 1EX
Telephone: (0992) 500919 Facsimile: (0992) 554261

CIRCLE NO. 602



simply because the scheduler just cannot accommodate an extra task or feature without a major rewrite.

Speed and size

One of the first questions asked of proprietary operating system vendors is: how fast is it? The implication is that the designer could do better in his dedicated system and speed is a critical factor. I concede that speed is one of the few areas where an in-house scheduler can do better than a bought-in rival. But these days there are a choice of operating systems available, from a bare minimum to a full operating system, and a sufficiently fast one exists for all but the most demanding applications.

Ironically, speed is also one of the few areas where system specification is a problem and a potential stumbling block to the system designer. Benchmarks are not standardised, and some vendors have exploited this by offering 'bare-bones' kernels that are optimised to perform simple tasks quickly. While these kernels are fast and predictable they don't actually do much. It is worth noting that a kernel is just that, and speed is sacrificed at the expense of capability. So when comparing interrupt latency times, for example, remember that additional code will be necessary as an overhead of the handler that services that interrupt.

That having been said, kernels may offer the best solution for a particular requirement and should not be overlooked. Remember that system designers using kernels may be forced to create and embed much of the operating system functionality in their application.

As for size - obviously a scheduler written for the particular application will only contain relevant code and should require less ROM space than the smallest suitable general purpose kernel or operating system. But is

this a real issue? With the level of memory density now available, and given that the kernel of an operating system such as OS-9 requires only 256 KB, this is not usually a problem. Because they are continuously being developed and optimised, commercial operating systems are very code efficient. Superior design, for example using re-entrant modules so that only single copies of each type of code module is required, where a more hastily developed in-house scheduler might require multiple copies. What you lose from lack of tailoring to your particular circumstances, you may well gain from the use of well-honed code.

Growth

The ability to provide functions over and above those needed to meet the original specification is not always obvious at project initialisation. Most (if not all) system designers have surely been asked to add extra features to the product once they have started. If it is just a slight enhancement which can be carried out by modifying application code, the cost just minor aggravation (and a chance to moan about the marketing department). But if it involves adding an additional task or I/O type it can be a major headache, bordering on the impossible. This is especially the case if the request comes years after the original design team has been disbanded or critical members left the company.

Proprietary operating systems have spare capability to accommodate these requests and their general purpose nature makes the addition of extra tasks a trivial matter. Even adding new features - a disk to a diskless system, networking capability etc - can often be as simple as adding the appropriate file manager, standard device driver and a code module to manipulate the data for communication between processes. And because the operating systems are fully documented, the engi-

neers following on have some chance of understanding the system.

Manufacturers of these systems are continually adding enhancements. If a new type of device becomes available - SCSI disks and NFS are recent examples - the manufacturer can usually supply appropriate drivers and revised versions of code so that the system maintainer can easily and quickly be added to the system.

Costs

At first sight a bought-in operating system may seem expensive, especially on large production runs. But so too are programmers and designers. An in-house scheduler can easily absorb a man-year of effort to design, build and document, and that doesn't include additional maintenance. Current engineering costs are in the region of £35,000 per man-year - these can easily double if contractors are employed. That amount of money can buy a lot of copies of a kernel or operating system. A ROMmed system containing, for example Industrial OS-9 for the 68000 chip (consisting of kernel, character I/O support and file handler) costs approximately £70 per copy at 50 off quantities, reducing to £25 at 1000 off orders.

The point here is that commercial operating systems should not be ruled out on cost grounds alone without a very thorough and critical analysis of the costs and other benefits associated with them when compared with an in-house design.

Reliability

The maxim that no software is bug-free leads to an advantage in proprietary operating systems, which should contain well tried and tested code. Clearly no vendor can guarantee his system to be entirely bug-free. However, if several hundred thousand copies are in everyday use and the system

PRO-C

Entry Level Offer

PRO-C V2.1

For DOS

£145

plus carriage & VAT

Pro-C is a trademark of Pro-C, Canada

- TECHNICAL OVERVIEW
- DEMO DISK 3.5"/5.25"
- UPGRADE INFORMATION
- PLATFORMS & PRICE LISTS
- SEMINARS

- I WISH TO TAKE ADVANTAGE OF THE 2.1 VERSION OFFER

Send to: EXPOTECH (U.K.)

Expotech House, 24 Western Road
Hove, Sussex BN3 1AF
Tel: (0273) 749222 Fax: (0273) 746446

name:.....

department:.....

company:.....

address:.....

postcode:.....

tel:.....

fax:.....

I enclose cheque/PO for £.....

F77L-EM/32 & Lahey Ergo OS/386

Port mainframe programs as large as 96MB to 386/486's with this 32-bit DOS-Extender compiler. The winner of PC Magazine's 1988 Technical Excellence Award just got better. New Version 4.0 includes: Programming Tools, Popular Fortran 90 features, Virtual Memory Support, DESQView support, New Documentation and Free Unlimited Runtime Licenses. F77L-EM/32 and OS/386.

£875.00 plus VAT

F77L

The fastest real-mode compiler available. F77L can take advantage of your 386 PC by generating 32-bit instructions. New Version 5.0 includes: Fortran 90 features, Weitek support, and Video Graphics.

Lahey Personal Fortran 77

Version 3.0: Full ANSI 77, Editor, Debugger, Linker, Library Manager, Microsoft and Borland C interfaces. A great learning tool at an unbeatable price.

£79.00 plus VAT

When people talk about FORTRAN
the name mentioned most often is

Lahey
Computer Software

System Science

3-5 Cynthia Street, London N1 9JF
Tel: (071) 833 1022 Fax: (081) 837 6411

CIRCLE NO. 553

CopyControl

THE NEW GENERATION OF COPY PROTECTION

- NO** User hassle
- NO** Back-up problems
- NO** Hardware add-ons or special disks needed
- NO** Changes to source code required
- YES** CopyControl beats ALL bit-copier Programs
- YES** Floppy disks, hard disks and networks supported
- YES** CopyControl is totally transparent to the user
- YES** You can limit program use by no. of copies, no. of executions or date
- YES** CopyControl works on all IBM compatibles
- YES** Free demo disk available

For Further Information Phone or Write to

microcosm

Microcosm Limited
17 Cranbrook Road, Bristol BS6 7BL
Telephone: 0272-441230 Fax: 0272-427295

CIRCLE NO. 554

The fastest way to learn C++ is also



the easiest way to learn C++ for only £49.95*

C++ is the language to learn and The World of C++ is the fastest, easiest and most cost-effective way to learn it. After just one week of concentrated study you'll be producing C++ programs. The World of C++ contains 21 lively lessons on 2 videotapes. As you work through the lessons you also work through an exercise book, learning to modify source code as you go. And, because you can quickly learn

C++ at home or in the office, you'll be developing your own ideas in next to no time (more quickly and less expensively than any other training course). Why not also take this opportunity to buy Turbo C++ at a special price.

* Excluding P&P and VAT.



You can now get both The World of C++
and Turbo C++ for only £99.95*
(Normal RRP £169.95)

To order call 0734 321150 (please have your credit card ready) or complete the coupon and return it to the address below, or fax it on 0734 320017. Alternatively, contact your local Borland dealer.

BORLAND
The Leader in Object-Oriented Programming

Borland International (UK) Ltd.
FREEPOST RG1571, 8 Pavilions, Ruscombe Business Park, Twyford,
Berkshire RG10 8BR. Tel: 0734 321150 Fax: 0734 320017

All Borland products are trademarks or registered trademarks of Borland International. Copyright© 1992 Borland International Inc.

TICK BOX

Please send me ____ copies of The World of C++ (£49.95* each - normal RRP £99.95)

Please send me ____ copies of The World of C++ and Turbo C++ (£89.90* bundle - normal RRP £169.95 for Turbo C++)

* Please add postage & packing and then VAT @ 17.5%. If spending up to £99 allow £5.00 for postage. If spending over £100.00 allow £7.50 for postage.

Disk size required 3 1/2" 5 1/4"

I enclose a cheque for £ ____ made payable to: BORLAND INTERNATIONAL U.K. LTD.

Please debit my credit card by £ ____

Access Visa

NO PURCHASE ORDERS ACCEPTED

Card Number _____

Expiry Date ____ / 199____

Signature _____

Name _____

Address (for delivery) _____

Postcode _____

Tel _____

Cardholder's name/address (if different) _____

AWOC22EX01-R2

CIRCLE NO. 601

has undergone continual development throughout its existence, it is safe to assume that bugs that do remain lurking deep in the code are unlikely to be encountered and so just as unlikely to cause catastrophic failure. The reliability of an in-house scheduler, especially a real time multi-tasking one, where it is impossible to extensively test for the whole range of extraneous conditions incident on the system, is far more questionable and might prove fatal.

Development

The ability to test an application program running under an operating system with tools optimised for that system is extremely attractive in terms of overall system proving and confidence. No matter how simple an in-house scheduler is, it is unlikely that a comparable range of tools exists. This in itself can save considerable development time. Some vendors supply cross development tools based on UNIX and PC hosts which allow strategic software development procedures and accounting packages to be employed - even for the lowest level embedded system.

How to cope with the forward rush of hardware technology? The DIY man faces

the prospect of porting both his application and his scheduler to any new platform. On the other hand, a commercial operating system is designed to be targeted on a variety of processors in a single form. Because manufacturers generally commit their products to new processors as soon as they become available, it is simple to take an application through a range of processors of present and future designs. For example software for the 68000 could be switched to the 68020 then the 68030 as greater processing power is required and the chip prices drop. People are doing this regularly. As the 68040 becomes available, the same code will run on it at the drop of a recompilation. Some operating systems can even compile code across different manufacturers' products, so it is theoretically possible to delay until after the software is written not only the choice of generic processor type (eg 68030/68040) but also the manufacturer and type of processor (eg Intel/Motorola).

Conclusion

While the initial cost of buying an operating system may look high in terms of monetary investment, training and development tool

commitment, it is unlikely to be more expensive than designing one's own scheduler. And when looked at as a whole, the range of benefits that accompany the bought-in kernel or operating system far outweigh the in-house scheduler over both short and long terms.

In essence the operating system should be considered as hardware: look for the most suitable, invest in training and tools, standardise throughout the company and reap the benefits of quantity, flexibility and understanding. That way expensive engineering effort can be concentrated on the specific application to yield a better product with a faster time-to-market.

EXE

Stephen Montgomery is Technical Sales Manager at Microware UK, and is a member of the IEE. He can be contacted on 0703 601991.

In the interests of fair play, the Editors of EXE would be most interested to hear from anybody whose experience is at variance with the situation as described by Mr Montgomery.

HiTOP

MICROPROCESSOR EMULATION FOR:

8051
68HC11
680x0
80C166

- **HLL Debugging**
- **Emulator Support**
- **ROM Monitor Version**
- **Windowed User Interface**
- **Test Harness Generation**

Contact us now for a demonstration version of HiTOP, configured for your CPU.

HiTex (UK) Ltd,
University of Warwick Science Park,
Coventry, CV4 7EZ

Tel: (0203) 692066 Fax: (0203) 692131

hitex

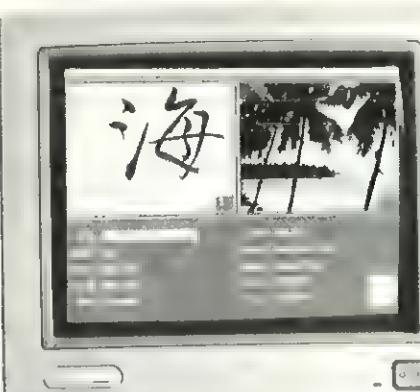
HiTOP
A Better
Environment

Escape with C-scape

ELEGANT GRAPHICS AND TEXT

C-scape Features

- Graphics — Combine high-resolution graphics with text or menus.
- Object-oriented — Add features and create re-usable code modules.
- Mouse — Use any standard mouse for fast screen control.
- Portability — Write hardware independent code. Supports MSDOS, OS/2, UNIX and VMS. Auto-detects: Hercules, CGA, EGA, VGA.
- Text Editing — Create a full-featured text editor or pop-up note pad.
- Field flexibility — Create masked, protected and marked fields with complete data validation. Use time, date, money, pop-up list and many more functions — or create your own.
- Windows — Choose from pop-up, tiled, bordered and exploding windows with size and numbers limited only by RAM.
- Menus — Choose from pop-up, pull-down, 123-style or slug menus — or create your own.
- Context sensitive help — Link help messages to individual screens or fields. Cross reference messages to create hypertext-like help.
- Screen design — Build any type of screen or form with Look and Feel™ screen designer, which will then automatically convert to C.
- Screen flexibility — Call screens from files at run-time or link them.



The C-scape® Interface Management System frees C programmers from the tedium of coding windows, menus, data validation, help and text editing functions.

C-scape is a pleasure to use. With C-scape's object oriented design you can build more flexible, more functional, more portable and unique applications — and you will enjoy doing it.

The Industry Standard.

Many thousands of programmers have given up home-grown libraries and cumbersome, inflexible products for the

CIRCLE NO. 555

ease of C-scape. In the US, IEEE Computer said "C-scape is by far the best ... a joy to use." PC Magazine chose C-scape to produce its Laboratory Benchmark Series 5.0 software because C-scape offers mouse support. Moreover, C-scape simultaneously combines text and graphics.

C-scape, from LIANT SOFTWARE CORPORATION, is built around an open architecture, so it can be used with data management or other C libraries. At Systemstar, we offer C-scape with Raima Data Manager from Raima Corporation to provide a complete development environment.

To port your application from MSDOS or OS/2 to UNIX or VMS, just recompile.

Source code is included in the price and there are NO RUN-TIME ROYALTIES.

For more information about C-scape call Systemstar on (0992) 500919.



SYSTEMSTAR

LIMITED

I-3 Parliament Square, Hertford, SG14 1EX
Telephone: (0992) 500919 Facsimile: (0992) 554261

EasyCASE™ Plus

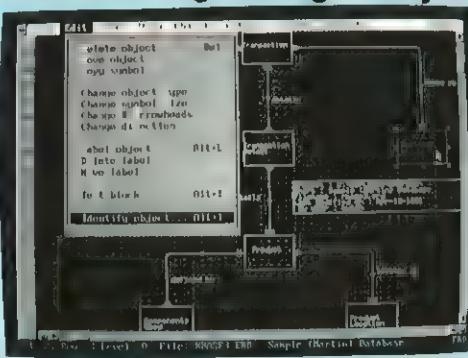
The affordable approach to software engineering... only £320*

Finally, there's a CASE tool that won't get in the way of your creativity... A tool that makes structured analysis, structured design and data modeling as easy as working with any other tool on your PC - EasyCASE Plus! Using EasyCASE Plus' new, easy to use graphical user interface (GUI), you'll be creating and editing charts, linking them, and building your data dictionary in no time. As well as being easy to use and easy to learn, EasyCASE Plus is easy on your budget! Ask any user. They'll tell you it's the best buy for your PC based CASE tool needs. Discover why over 4,000 software professionals use EasyCASE Plus and how you can join them!

Requirements:

Runs on: IBM PC or PS/2 (AT recommended), DOS 3.1 or higher, EGA/VGA color, mouse, 640K RAM (500K free), 1 MB EMS recommended, math co-processor supported. Printers/Plotters Supported: Epson FX & LQ, IBM Graphics & Printer X24, HP QuietJet, DeskJet, & LaserJet, HP Plotters, PostScript.

EasyCASE Professional £420*
(includes integrated DFD level balancing and data dictionary/diagram analysis)



"EasyCASE Plus is a well designed, low priced tool that is easy to learn and provides excellent diagramming capabilities... EasyCASE Plus is an excellent investment."

COMPUTER LANGUAGE
PRODUCTIVITY
AWARD
1990

Features:

- IBM SAA/CUA compliant graphical user interface (GUI)
- Extensive diagram editing features
- Integrated dBASE III compatible data dictionary
- Integrated dictionary manager, reports manager, process editor
- Hierarchical chart linking & process decomposition
- Record and element definitions
- Extensive printer, plotter and desktop publishing support
- Data dictionary import, export, and merge
- On-line help
- Comprehensive documentation with tutorial access
- Access to your database, word processor, DOS, etc.
- Integrated diagram analysis (optional)

Methods:

- Yourdon/DeMarco
- Gane & Sarson
- SSADM (DFDs)
- Ward-Mellor/Hatley
- Yourdon/Constantine
- Martin
- Chen, Bachman

Diagram Types:

- Data Flow Diagrams (DFDs)
- Structure Charts
- State Transition Diagrams
- Entity Relationship (ERDs)
- Data Model Diagrams
- Transformation Schema (real-time DFDs)

Evergreen
CASE
Tools

THE
SOFTWARE
CONSTRUCTION
CO. LTD.
FAX: (0763) 244025



Call today for a brochure!
Tel: (0763) 244114



Yet More Bjarne

Will Watts ambushed C++ inventor Dr Stroustrup with a recording Walkman during a recent visit to London to speak to the European C++ Users Group. Here is what he had to say.

What is the situation with the ANSI and ISO C++ standardisation committees?

Given the experience that other languages have had with standardisation, we had every reason to fear trouble. Since at least the days of FORTRAN, there seem to have been institutionalised fights going on between the various national bodies. But we had the first ISO meeting in Lund last summer, and we agreed to hold joint meetings and produce one document.

I have high hopes that standardisation will go smoothly. The process worked in Lund, it worked in Dallas a few weeks ago and we just expect it to go on.

When can we expect some public results?

We hope to produce a Draft Standard somewhere in '93, and a final draft for approval in '95. Of course, the whole proceeding is public and anybody can be an observer and anybody can be a member too; but you can only be voting under ISO rules if you are a national representative and under ANSI rules if you are a company rep. If you are a one man company then that's fine; the rule is there to stop IBM, AT&T and so on loading up the committee.

Several members are making it their business to inform people about what is going on so, although the first public draft is in '93, this isn't a secret process by any stretch of the imagination. I think there are 280 members that get all the written material, and 70-odd people present at a meeting who report home.

Some languages, such as Borland's Turbo Pascal, provide a `typeof` mechanism, by which you can obtain type information from classes at run-time. Are there any plans to incorporate such a mechanism into C++?



We are looking at it. There's a proposal coming out from Hewlett-Packard, and I've also worked on it - that's what's reflected in my book (*please see The C++ Programming Language, 2nd Edition, pub Addison Wesley 1991 - Ed*). It's top of the list of things that we are considering. I guess that something will be approved along the lines described in my book.

There are three issues that are important: what is the language level interface of the type information? what type information is guaranteed to be available? and how do you attach more information if you need it?

One thing that can happen, if you don't get this right, is that you load every application up with a couple of megabytes of type information. That must not happen. We have the principle in C++ of what you don't use you don't pay for. I would not like to

see an application where if you didn't use type information you got an extra byte anywhere - and I think we can do that.

The actual interface is heavily biased towards the idea of a safe cast, as opposed to a `typeof` operator, because it's easier to get the correspondence between the static type information and the dynamic type information right with the safe cast. It also means that you don't first have to ask what the type is and then cast - as in the traditional approach. So I think it is much better to have a pointer cast operator than a `typeof` operator or a `kindof` operator - you get shorter, safer code with fewer bugs.

Are you rejecting anything that adds an overhead to C++?

That was not quite what I said. I said you should only pay for it if you used it. If you

use a little bit, it should cost you a little bit, and if you used a lot, you pay out in loads. And I guarantee if you want everything in type information it will cost you a lot. It does in every language and there are fundamental reasons for it.

Libraries

Do you have any plans to expand C++'s Standard Library?

Yes. The Standards committee is working - and has worked for some time - on ways of specifying a library, using the I/O stream library and the string library as guinea pigs. They are now expanding their research to include simple container classes like the vector, associative array (aka 'map' or 'dictionary'), maybe bitmap - trying to identify a nucleus of things that can be made available. I hope this is feasible without tying down everybody to the same architecture.

One fundamental aspect of our approach is that we're trying to build concrete types that are as optimum in time and space as you can get, and then looking at more abstract types built on them to provide generalisations. Contrast this with the Smalltalk way of building everything on top of a single base class, which imposes an overhead on everybody. It's another case of what I just said: what you don't use you don't pay for. If you want to use an associative array and I want to use a string, I don't want the overhead that is necessary for the associative array and you don't want the overhead that is necessary for a string. We should be able to separate the world in this way.

So you are completely against 'cosmic' libraries?

Oh yes. I don't think a universal data type has any place in C++. It's one of those things... If you have a universal base class in your design you are stuck. The idea of a universal base class is poison. It means that everything has to go towards that class, and everybody has to agree to get anything done. Yes, you get that standard library, and that will give people a leg-up, but you can't get further.

Smalltalk-style libraries have their place, but they're very limited. If you have Smalltalk-style libraries, and I don't, I can co-operate with anybody else that doesn't. You can't co-operate with anybody that either agrees with you on your philosophy - because they have their own universal class - or with somebody that agrees with me - because they don't want your universal class. Therefore you have to set out to take

over the world. The world is too big for that.

This is quite a strong position that you're taking...

Yes. I have been saying it for years. People don't want to believe me, because they

Someone must have sold him the idea of OOP as a solution to everything - one of these flaming religious types

want the One True Religion. It may be Smalltalk, or some derivative of LISP, and these days Eiffel seems to be very popular among preachers. If people learn from preachers then they get into bad habits. They write programs that are big, clumsy and that run slowly, and they get very expensive failures when they can't deliver. They also get concepts they can't master. Maybe they could master them next year - that's fine - but take your time, and grow up along the way.

If you want Smalltalk, for heavens sake use Smalltalk - it's the best Smalltalk around. If I had wanted to build a Smalltalk implementation then I could have built a much better one than C++. It is not a Smalltalk implementation. Sorry if I emphasise it so much, but I keep on hearing this and I don't want to.

OOP

I'm beginning to hear programmers make remarks along the lines of: 'OOP and C++ are all very well, but marketing people and journalists have been hyping them something rotten... They don't offer the ordinary working programmer anything very much.' How do you react to such a remark?

If someone said that, I'd think that someone had sold him the idea of object oriented programming as a solution to everything... in particular that you have to make everything derive from a single base class, or maybe make all your functions virtual - one of these flaming religious types. If he has

run into that, and he thinks that is what C++ is supposed to be, then it's an example of a thing that I worry about quite a lot: bad teaching.

I recommend that you start slowly. Start using C++ as a better C, take advantage of the type-checking and the better notation, use a little bit of data abstraction, maybe use some libraries that do something useful for you, say X window interfaces, or mathematics. Pick up something that fits; go slowly from ordinary C to more type-safe C with a little bit of data abstraction. And then later, when you have some need for it, start using a bit of class hierarchies where they fit. This idea that you have to go all object-oriented to get benefits is hype, and it doesn't come from me and my friends. It comes from people who are trying to over-sell various other languages.

Eiffel influences

You mentioned the 'E-word' - Eiffel - a moment ago. It seems to me that a lot of things that were originally in Eiffel have appeared in C++ over the years -

- and vice versa -

- and vice versa. One thing that Bertrand Meyer/Eiffel is very hot on, which is conspicuously absent from C++, is language support for preconditions/postconditions etc. Do you 1) think that these things are useful, and 2) if yes, would you consider incorporating them into C++?

Well, 1) they are useful and 2) they don't belong in the language. If you just want pre- and post- conditions, you just use either an assert macro or template. You don't need the language support to get most of the benefits. Secondly, if you need support in terms of verification technology and such, you can use an annotative language that uses a much stronger technology than you can build into a compiler. Then you get into something like A++, which has a verification system which is stronger than you get from something like Eiffel. But it is not in the language, it is a separate tool, like a design tool.

The Eiffel crowd in general, and Bertrand Meyer in particular, has a tendency to say that certain features are not only 'good' but 'essential' for writing software, and that certain features are not only 'not very important' but they are 'bad'. This is very much against the way I think. You can write reliable software in anything - even assembler. It's just a matter of convenience and

ease of modification once you have done it. What we are dealing with, in my opinion, is a trade-off between what the language provides, what you have to provide by tools and what you have to do for yourself. I have voted with my feet several times for putting things in the language that, for instance, the C crowd and the Pascal crowd said wasn't necessary. But it's useful - it's proven useful in real use.

We always promised that C++ would grow. If you look at my paper *What is Object-oriented Programming* from '86 it says that there are problems with C++. 'We don't have templates (as they are now called). We'll have to put in something to fake them - it will probably be better to have language support, I think that we'll get them some day.' It's the same for multiple inheritance and exceptions, and we are now looking at run-time type identification. If you read the first paper from back in '81 on 'C with classes', it said that I was looking at a range of possible extensions, and listed some things we might get when we understood them a bit better. It's interesting that multiple inheritance was on the list back in '81. It took me until '87 to figure out how to do it in a way that fitted.

Yes, C++ does not have everything. I don't think it should have everything. But it's not a static entity. And whatever the Eiffel people say, Eiffel is one of the fastest changing languages around. They realise it. Just for some reason - probably marketing - they don't admit it out loud the way we do.

In fact, if you look in my book there's a rather neat template for doing assertions. It doesn't give you everything you can get in Eiffel, but Eiffel doesn't give you everything you get in an annotation system like A++.

How do you respond to criticisms of C++ being 'impure'?

It is not right to be pure. It is right to serve your own and others' needs. Diversity of approaches has been shown to work. There's not just one right way, and anyway I have a problem with the word 'pure', because it makes me think of Storm-troopers. I have a problem with the people who think there is one right way for ever-more. They can't get along unless everybody does it that one right way. It's a fundamental flaw in a language.

About your new book...

The new version of The C++ Programming Language struck me as quite different from the previous edi-

tion: more readable and less academic. Is this deliberate?

Writing is the only thing you learn by [w]rote... so some changes you can attribute simply to reading the thing over again. But the conception of the two books is the

Borland's argument is that nobody would ever want that feature on a system that wasn't mad

same. They both try to give people enough information to complete significant projects successfully, based on the experience I have had of problems that people really run into. In '85 one set of problems was bothering people, and now, six years later, there are different problems. Some things are not so much a problem any more, because people have learnt to cope. Other things are more problematical, because users have come in with more various backgrounds, and some side issues have become much more significant. More people are writing C++ programs. In '85 we were dealing primarily with teaching programmers working

in small groups. Today, there are many many groups, some of them large, and this dictates the shift in the discussion.

But if the book's more readable then that's very nice, because I worked like mad.

MS C++

What do you know about Microsoft's implementation of exception handling in C V7.0?

Nothing. Well, that's an overstatement, but a close approximation. I know they were dabbling with resumption at some point, but I don't know if they still are. So 'nothing' is a fair answer. But don't take it as being criticism or comment or anything, it's just: yes, I've talked to some of the guys who worked with it but I don't know what they actually went and did. I certainly don't have any opinions on it.

Do you think the release of MS C++ will increase acceptance of it as a 'better C'?

There's two questions there, especially as 'a better C' is a buzz-word in the C++ world. Yes, I think that Microsoft coming out will help the acceptance of C++, though with Zortech and Borland already out it will be another stage in acceptance rather than some revolution.

Microsoft will, of course, bring in new programmers. My recommendation is that new programmers should start with a 'better C' level of C++ until they have had time to learn more. So if, as one would expect,

Problems of C's declarative syntax

The implicit `int` problem is shown by:

`int f(const T);`

Is `T` a type name (so that `f` takes an argument of type `const T`) or is `T` a variable name (so that `f` has an argument call `T` of type `const int`)?

Had `int` been required for all `int`s, the user would have had to write:

`int f (const int T);`

in the second case, and there would have been no opportunity for confusion.

The following is hard to read:

`int (*v[10])(char);`

which is an array of 10 pointers to functions taking a `char` argument and returning an `int`.

The problem is that to interpret this is that you must read the declaration line 'inside out'. What would have been much easier to read and write would have been a linear notation (like the English above). For example

`v[10]->(char) int // full`

or

`int v[10]->(char) // halfway`

The latter is a compatible C extension discovered circa 1981 documented by Rani Sethi in SP&E paper.

Figure 1 - C's declarative syntax

If you thought you couldn't afford full ANSI SQL ...

The conSQL package offers a complete relational database management system which supports both ANSI level 1 and level 2 SQL.

The system runs in a totally integrated environment which includes :

- A multi-user SQL database processor.
- Report Writer.
- Screen Painter.
- SQL Query Builder.
- Comprehensive Online Help.
- 'C' Application Program Interface (API).

With conSQL, multi-user operation is implemented through communicating processes enabling the SQL engine to manage asynchronous transactions received from more than one user. Database security is maintained through the use of ANSI GRANT and REVOKE statements which can operate at the table level, the view level or at the individual column level.

In addition, conSQL incorporates useful extensions to the ANSI spec. such as the screen painter which allows generation of forms which can be used to input data directly into tables.

The query builder allows users who are not familiar with SQL to build ANSI/ISO SQL queries step by step.

conSQL is extremely efficient, using field indexing (b+tree) for very fast query processing as well as single word commands to store and run commonly executed queries.

To find out what conSQL can do for you phone us on the number below.

...Think again. conSQL

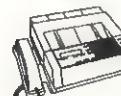
£375 + VAT

conSQL multi-user SQL runs under MS-DOS 3.x or greater.

For further information, or to place an order, phone/fax now.

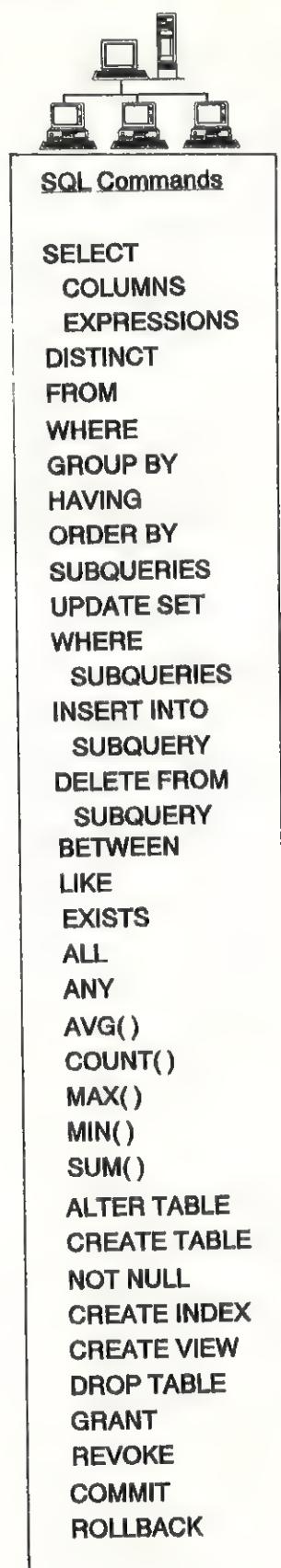


Phone (0533) 739082



Fax (0533) 739401

Contrast Systems Ltd.,
22 Baslow Road,
Leicester LE5 5HD



Microsoft C++ brings in a large number of new C++ programmers, then they will be a lot of 'better C' style C++ programmers. That is exactly how I want it. Then you wait six months to a year, you'll find quite a lot of 'better C and data abstraction' style programmers. Wait the same time again, you'll find there are a lot more programmers doing much better abstraction code, much better class hierarchies, and much 'type-safer' code. I think this is an important difference between C++ and some other approaches.

You don't expect things to happen in one step. I strongly hope that the new C++ programmers will read books like mine and others that are cautious. On the other hand, a lot of books just try to say: 'Well, we need to have purity of approach. Go overboard and do everything at once. If you can't figure it out then you shouldn't be licensed to write a program.' There's lots of good books and even more bad books, and I just hope that people will be a bit careful. I also hope that journalists won't declare C++ dead because people will - as they should - write better C in the beginning.

But won't people just write better C forever, and never write real C++?

Oh, they never stop learning and improving. My experience is people do not stop with 'better C'. They slide along very nicely, provided they have half a reasonable educational experience and materials. It takes a little time, but it always happens.

But going in at the deep end - saying you can't write any C++ until you can write some major class hierarchy - is just asking for failures. We've seen such failures in other languages, but not to my knowledge on a big scale with C++. Caution is what keeps it that way.

What if you are a virgin C++ programmer coming onto a mature project where many classes already exist...

It is so much easier to use a class than to design it.

So you're not discouraging novices from using class libraries?

Oh no. Use the class libraries. Use the libraries that you can either buy or that are used in your project. The simple example is: using a string class is far easier than using the C primitives for string manipulation. Writing a string class is almost a rite of passage. Everybody has to write two to try and come to grips with the abstraction

mechanisms in C++. So write your string classes - then go and use somebody else's.

A Maritime Parable

With the introduction of templates and exception handling, do you see the C++ language as essentially stable or are there other major issues still to be addressed?

C has in some sense stopped growing. The pipeline is not being primed with new C stuff, it's being primed with C++

There's two aspects to stability. One is: to stop growing. The other thing is if old code breaks. One of our official aims in the ANSI and ISO process is to make sure that as little as possible code breaks - and preferably none. If something is indisputably a legal C++ program, it shouldn't break. It's as simple as that.

You can grow and still maintain stability by adding things compatibly. I think the major features are in place, but people propose new features very, very often and with great fervour. We're looking at a lot of things. Top of the list is the run-time type identification issue.

I often tell people about the good ship Varsa. This was built in Sweden during the 17th century to be the biggest and the best and the most beautiful battleship in the Swedish navy. But somewhere during construction came the notice that somebody else was building bigger battleships. And it was observed that if this wonderful Swedish battleship came up against a battleship with two gun decks, the Swedish ship would be on the bottom with a lot of holes in it very fast. So they decided to make a quick correction to this problem and added another gun deck. The ship now got even more beautiful, as there was room for even more sculptures. The designer was literally

driven to his grave out of worry about what was happening. The ship made it half-way across Stockholm harbour and keeled over and sank killing 50 people. Which is why you can go to Stockholm today and see it, and it's a wonderful sight to behold - much prettier than if it had gone to the bottom the traditional way.

There are limits to what you can do to a language like C++, and we're very careful about that. I think that if all people want all their favourite features from all the languages they have ever used, they should spare a thought for the good ship Varsa.

Borland's bits

What is your view of Borland's DDVT extension to the language to cope with message handling in the Windows GUI environment?

There's two things that have to be remembered. You have to remember both of them, because either one by itself doesn't sound very good. First: I don't like extensions. Second: sometimes they are necessary. When you have architecture as weird or as warped as the original PC architecture, you probably need some extensions. Some of them are relatively benign. Near and far may be considered perverted, but it does not harm the fundamental structure of the language. On a Cray you might have very different kinds of extensions. Sometimes they're the only way of getting a general-purpose language to take advantage of special architectural or operating system features. But it's always a judgement: When is something a warp of the language to take advantage of a particularly warty environment or architecture, and when is it a general-purpose extension that everybody has to live with?

I know Borland's argument, and that is that the feature is there simply to fit into a weird environment, and nobody would ever want that feature on a system that wasn't that mad. Therefore it's no problem. I actually don't know enough about the case in hand to see if their argument is true. It could be a marketing ploy, and it could be perfectly true. It's not my job to judge that one.

Do you think that C++ needs some kind of mechanism - not necessarily DDVTs - to handle GUI programming more efficiently?

You can design your GUIs so that you don't need that kind of extension. I don't think that the language should have features simply to support bad designs. If somebody can prove that it's not a bad design, but a

● QUALITY TRAINING EVERY WEEK OF THE YEAR ●

THE COMPLETE PICTURE FOR C & C++ TRAINING

A fully comprehensive range of hands-on workshops

FOR PROSPECTIVE C PROGRAMMERS ...

Introduction to C Programming & Design
This course teaches C to new programmers, focusing on good programming practice and techniques.
Duration: 5 days **Cost:** £900
Frequency: Monthly

FOR NOVICE C PROGRAMMERS ...

C Booster
This hands-on workshop teaches the tools and understanding required for a broader knowledge of C.
Duration: 2 days **Cost:** £400
Frequency: Monthly

FOR HIGH LEVEL LANGUAGE PROGRAMMERS ...

C Programming Workshop
The course provides a hands-on introduction to C, teaching the syntax and semantics of the language.
Duration: 5 days **Cost:** £950
Frequency: Weekly

The Instruction Set has the right course for you

FOR EXPERIENCED C PROGRAMMERS ...

Advanced Programming in C
This course addresses the more advanced aspects of C and advanced programming techniques, including implementation of abstract data structures.
Duration: 5 days **Cost:** £1000
Frequency: Monthly

FOR EXPERIENCED C PROGRAMMERS ...

C++ Programming Workshop
This introduction to C++ teaches the constructs of the language and emphasises the use of object oriented techniques.
Duration: 5 days **Cost:** £990
Frequency: Monthly

Save Up To 20%

Series Booking, Complementary Courses Booking, Early Booking and Partnership Programmes make it easier for you to take advantage of premium quality training at a reduced price.

THE INSTRUCTION SET
Hoskyns Open Systems Training
071 253 5121

I would like to reserve a place on:
Course Title: _____
Please send me a course outline, a training schedule and booking form
 I would like more information on the above courses
 I am also interested in other training from The Instruction Set:

| | |
|--|---|
| <input type="checkbox"/> UNIX | <input type="checkbox"/> Programming Languages |
| <input type="checkbox"/> AIX | <input type="checkbox"/> Object Oriented Technology |
| <input type="checkbox"/> Communications & Networking | <input type="checkbox"/> Relational Databases |
| <input type="checkbox"/> Windows | <input type="checkbox"/> OS/2 |

 Please phone me to discuss my training requirements

Name _____
Position _____
Company _____
Address _____

Telephone _____

Clip the coupon and return to:
The Instruction Set, FREEPOST (NW3832), London, EC1B 1DP
Or fax us on: 071-251 2853
Any enquiries please call us on 071-253 5121

The Instruction Set acknowledges all registered trademarks EXE 3/92

● QUALITY TRAINING EVERY WEEK OF THE YEAR ● QUALITY TRAINING EVERY WEEK OF THE YEAR ● QUALITY TRAINING EVERY WEEK OF THE YEAR ●

fundamental necessity of GUIs then yes, of course the language should be extended to do it, but I doubt very much that is the case.

You've said on record that C's declarative syntax was an experiment that failed. Did you have an alternative in mind?

Oh yes. I can give you off-line an example of this (Figure 1) that looks really weird. But don't get anybody's hope up. I tried to get it done years ago - and failed.

How do you feel about the large growth projected for C++? Your own estimates of growth seem to be quite conservative, compared with the results of the .EXE reader survey.

If I didn't round down my estimates heavily they would be hype. The take-up may well be larger, but let's wait and see. My feeling is that C has in some sense stopped growing. People don't build C tools any more, people don't build C compilers any more. There's still some backlog coming out, but the pipeline is not being primed with new C stuff, it's being primed with C++.

I doubt that that many people will actually be doing C++ in half a year, but they will in a year. Probably in six months all the new compilers will be C++, meaning that if people want to use the latest compilers or the best code generators and such, they'll be using C++. A year from now they will

I just hope they can benefit from other people's experiences. Of course, I recommend my book, but there's other good books too. My rule is: look to see if there is a history section, and look to see if there is a lot of hype about object-oriented programming at the beginning; and if there's no history and there's object-oriented hype - don't touch it!

I don't think a universal data type has any place in C++ - the idea is poison

have stopped using the C compatibility switches, and they will have verified for themselves that there are benefits in the stronger type checking. They will all be looking at the data abstraction and inheritance mechanisms, hopefully with sensible suspicion. And a lot of them will be starting to use it.

Of course there's people with other temperaments than mine, who have more courage (or foolhardiness) than I have. I prefer to see people moving relatively slowly and manageably. Don't rush to the other end, because by and large you'll get there in the same time anyway. In my mind, doing a sprint and then having to walk because you are puffed is not a good strategy. Some people like it that way - but they'd do it anyway, whatever I said.

.EXE

Many thanks to Dr Stroustrup for sparing the time to give this interview, and to the folks at the European C++ User Group for setting it up. Call ECUG on 071 2535121.

WHO? WHAT? WHEN? WHY?

SMS : the fully integrated, automated control system for software changes.
Takes the guesswork out of revision history and configuration management.



A full set of software management tools accessible via a menu-driven front-end with context sensitive on-line help

• Version Control

- Manages multiple revisions, development lines, users
- Revision Identification and reporting
- Text and Binary file support
- Minimisation of storage

• Configuration Management

- Manages configuration items of a product/project
- Release and Configuration identification
- Automated system building
- Automated dependency generation

• Modification Requests

- Formalise bug reporting and upgrade procedures
- Definable life-cycle with active notification system
- Change management
- Modification analysis and reporting

Multi-platform: MS-DOS, Unix, VMS, OS/2, OS-9
PC Prices : 1 User £490, 5 User £980

 (0392) 217670

INTASOFT

for professional software developers

Intasoft Limited

Tresco House, 153 Sweetbrier Lane, Exeter, EX1 3DG, England Tel: 0392 217670 Fax: 0392 437877

System Science

• Software • Specialists • Software • Specialist • Software • Specialists • Specialist • Software • Specialists •

Unix

SCO Unix Op. Sys SCO Unix Dev Sys.
 SCO Open Desktop SCO ODT Dev Sys
 SCO TCP/IP & NFS FTP PC/TCP
 Interactive Unix Op Sy / Architect Series
 Informix 4GL & SQL RM Cobol-85
 LPI Compilers C Scape Screen Lib
 LPI C++ (native) 386 Unix & Sun- NEW
 ... many more for 386 Unix and Sun

Microsoft

MS C/C++ 7.0 NEW!...NEW!
 Quick C for Win NEW!
 MS Fortran 5.1
 MS Windows SDK
 MS Basic Compiler 7.1
 MS Cobol 4.5 (DOS & OS/2)
 MS Macro Assembler 6.0
 MS Visual Basic
 MS Quick C 2.5
 MS Quick C & Assembler
 MS Quick Basic

£225.00
 £99.00
 £210.00
 £210.00
 £225.00
 £460.00
 £79.00
 £99.00
 £60.00
 £99.00
 £60.00

C/C++ 7.0 competitive upgrade £99.00
 call for details

C++ Compilers

also Microsoft & Borland
 Zortech C++ Dev Ed (incl OS/2) £345.00
 Zortech C++ Sci & Eng £525.00
 JPI TopSpeed C++PExtend £175.00
 JPI TopSpeed C++ SE £115.00
 JPI TopSpeed C++ PE £175.00
 JPI TopSpeed C++ Pro Dev. £229.00
 Watcom C 8.5 £275.00
 Watcom C386 8.5 with ADS Supp £495.00
 Aztec C 86 (with ROM support) £265.00
 TopSpeed C PE £175.00

Mathematics

Derive - The Mathematical Assistant
 Mathematica 2 Windows (now in), 386. MAC
 Mathematica for Workstations (Sun, HP..)
 MathCad for Windows (new) GrafTool
 What's Best! Lindo
 SPSS/PC, Statgraphics Chiwriter Sci WP

Windows Development

(see Microsoft , Borland, Zortech, Watcom)
 CASE:W Corp. £645.00
 Smalltalk/V Windows £295.00
 Btrieve for Windows £345.00
 Object Trieve £call
 Commonview £395.00
 Win++ by Blaise £150.00
 Windows Control Pallette - Blaise £95.00

Borland

Borland C++ & AFW new 3.0 £295.00
 Borland C++ (Dos / Win) 3.0 £195.00
 Turbo C++ Windows NEW! £85.00
 Turbo Pascal Windows £99.00
 Turbo C++ & Turbo Vision NEW! £75.00
 Turbo Pascal 6 £75.00
 Turbo Pascal 6 Prof £135.00
 Turbo Debugger and Tools £89.00

Authorised Languages Dealer

Nu-Mega Tech.

Bounds Checker (386) £169.00
 Soft-Ice/W (Windows) £259.00
 Soft-Ice (for 386 DOS) £259.00
 Magic CV 3.0 £135.00

Borland C++ & AFW only £189.00
 for owners of MS-C, Quick C, QC Win,
 Zortech C++ & JPI ...call for details

C Datafile

CodeBase 4.5 for C, C++, Win- new £235.00
 Btrieve - DOS or Windows ver £345.00
 Ctree Plus from Faircom £345.00
 Faircom Professional Toolbox £745.00

C Communications

Essential Comms £175.00
 Greenleaf CommLib £195.00
 C Asynch Manager (Blaise) £115.00

C Screens

CScape with Look & Feel £365.00
 Vermont Views 3 £335.00
 Panel Plus II £275.00
 Zinc for C++ (Win & Dos) £225.00

C Graphics

Essential Graphics & Chart £195.00
 PCX Programmers Toolkit £155.00
 Halo £195.00
 Metawindows £195.00
 ... many more libraries

Intersolv (Authorised)

PVCS for Dos £345.00
 PVCS Config Build (PolyMake) £145.00
 PVCS Networks, OS/2 & Sun £call
 PVCS Professional Editor (SPE) £155.00

MKS

MKS Toolkit new ver 3.2 £155.00
 MKS RCS new ver 5.1 £145.00
 MKS Lex & Yacc new ver 2.6 £145.00
 MKS multi-user and OS/2 £call

Tools and Editors

Brief 3.1 £195.00
 Kedit (Xedit for PC) £99.00
 .RTPatch for DOS, Win & OS/2 £195.00
 .RTLink Plus £295.00
 Plink 86 Plus £275.00
 Personal Rexx new ver 3 £110.00
 Ghost (auto software testing) £135.00
 EasyCase Plus £345.00
 C Programmers Toolbox £175.00
 CDOC £145.00
 ... and many more tools and utilities

Fortran Compilers

Lahey F77L £375.00
 Lahey F77L-EM/32 with OS386 £875.00
 Watcom F77 386 8.5 with ADS supp £495.00
 Salford FTN 77-386 £765.00
 PC/Interacter (screens) £325.00
 Ingraf Graphics source £195.00
 ... many Fortran Libraries

Power Basic £89.00
 many Basic libraries for comms, graphics
 PC Logo £50.00
 LMI UR/Forth £295.00
 Smalltalk V/DOS £69.00
 muLISP 90 £225.00
 RM Cobol-85 (new Dev Pack) £call.
 MS DOS 5.0, £call.
 QEMM 386 £65.00

- Prices are exclusive of VAT.
- Prices include delivery to GB.
- Prices are subject to change.
- VISA, Access and Mastercard welcome with telephone orders.

3-5 Cynthia St
 London N1-9JF
 Fax: 071 837 6411

• Software • Specialists • Software • Specialist • Software • Specialists •

071 833 1022

DOUBLE YOUR HARD DISK WITH STACKER.

Stacker instantly doubles the size of your existing hard disk - so 20Mb becomes 40Mb, 40Mb becomes 80Mb, 80Mb becomes 160Mb, and so on. And at no risk to your valuable data.

Stacker is 100% compatible with MS.DOS, DR. DOS & Windows, it installs in an instant and is totally invisible in operation. It's the market leader in the USA and the industry standard used by Peter Norton Computing, Central Point Software, Exabyte, Megatape, Tecmar, and Wangtek.



from
£99

£99 for STACKER SOFTWARE

Double your hard disk instantly.
Four versions are now available starting with...

■ Software only at £99 plus VAT (ie. £116.33) which is perfect for portables, laptops and notebooks, or where there are no available expansion slots.

But if you want small driver size and the highest possible speed and compression ratio then just choose one of the three hardware versions.

DOUBLE YOUR HARD DISK AND SPEED UP YOUR XT/AT/386/MCA PC

■ The XT/8 with Coprocessor board and Software at £129 plus VAT (ie. £151.58) which is designed for IBM PCs and compatibles (ie. Intel 8088/8086 based machines).

■ The AT/16 with Coprocessor board and Software at £159 plus VAT (ie. £186.83) developed for IBM PCs and compatibles (ie. Intel 286/386/486 based machines).

■ And the MC/16 with Coprocessor board and Software at £189 plus VAT (ie. £222.08) which is specially produced for the Microchannel environment.

"Easy to install, massive performance benefits without hardware outlay, completely transparent."

"As a simple way of upgrading a system without hassle, it is hard to imagine a more useful program."

— Personal Computer Magazine

YOUR NO NONSENSE GUARANTEE FROM TKH

Risk free purchasing with free technical support.
TKH International specialises in powerful products at very competitive prices. We deliver free of charge in England, Scotland and Wales. And provide FREE instant Technical Support through our Hotline Experts. All our products come with a No-nonsense, 30-day Money Back Guarantee. So, if you're not completely satisfied, simply send the product back and we'll refund your money.

HOW TO ORDER

Simply call

081-995-4500

to use your Access, Visa or American Express Card. Or, send a Cheque or Company Purchase Order made out to TKH International at TKH INTERNATIONAL, FREEPOST, LONDON W4 5BR

TKH
INTERNATIONAL

Please quote ref GS1

CIRCLE NO. 560



Life without Huffman

The Huffman approach to data compression is the best known, but it can be hard to implement. Crosbie Fitch has stumbled upon an alternative.

To date, Huffman Code stands as the most efficient, direct method of encoding an arbitrary number of tokens of varying frequency into variable length binary sequences. However, it is not particularly easy to implement. For those of you that would prefer something easier to digest as well as implement, while being of comparable efficiency, I'd like to introduce you to Unary Prefix Code (UP Code).

Just like sorting algorithms, where there is still a place for the bubble sort, I think it would be a pity if we forgot the less efficient coding methods. They can be quite educational, not to say useful in some situations.

Like many programmers I've done my share of re-inventing the wheel. Indeed, most programmers usually recognise when a discovery is liable to have already been discovered and is thus a mere re-invention. Of course, there are times when things go the other way; a real discovery is dismissed by its author until it's recognised to be original (nearly always by someone else). This was the case with Huffman code (see *Scientific American* September 1991, p27). David A Huffman developed the method in response to a term paper problem set by his professor, who surprised him upon revealing that its solution had, until then, not been perfected.

I discovered Unary Prefix Code in ignorance of Huffman Code or the idea of using binary digits as directions for traversing a coding tree. For those of you that don't know, a detailed description of how to implement Huffman Code is in the book *Algorithms in C* by Robert Sedgewick (pub Addison-Wesley, ISBN 0-201-51425-7). When I heard about Huffman Code I thought that it was what I'd re-invented. No such luck. I'd only discovered a slightly slacker coding scheme that I suspect was old hat to David Huffman and his fellow academics. Nevertheless, it does have its merits and, though not optimal, has the appeal of being simple to understand and implement.

How it works

The idea of all such encoding is that given N different items occurring F_n times in a sequence, how can you represent each item as a variable length binary code so as to use the fewest number of binary digits in the encoded sequence? Obviously the items that occur most are given the shorter codes, but the question is: What codes should be used and precisely how should they be allocated? A typical application is that of compressing an 8-bit text file where only a few of 256 possible characters are used, and furthermore, have markedly different frequencies ('E' occurs far more than 'Z').

Unary Prefix Code is as it's called; giving a binary number a unary most-significant-digit. Moreover, the binary number, or suffix, is of variable length.

Now, being unary, the prefix enhances the range of lengths of the code and so becomes ideal in situations where there may be a wide variation in frequency. It allows total flexibility of code length, where with a fixed length binary prefix you sacrifice being able to have very short codes for the lesser benefit of having shorter, long codes.

One example of a useful binary prefix code is where the msb of a byte determines whether the following value is stored in one byte or two. This allows values of 0-127 in 8 bits and values of 128-32895 in 16 bits.

So, in summary, UP code uses the prefix to encode information about which group of items are represented by the suffix and how many items are in the group.

Unary

You're probably wondering how unary numbers can be implemented on a binary processor. Well, you can, in the same way that you can implement a series of decimal digits in hexadecimal, where you can consider every digit decimal until you find one greater than 9. Unary is quite similar. Every '0' bit is unary until you find a '1' (reading from left to right). Thus 0,1,2,3 in unary is "0", "00", "000" and "1", "01", "001", "0001" in BCU (Binary Coded Unary) - see Figure 1. I won't go into philosophical discussions here about whether zero can be represented in unary!

Let me demonstrate with a very simple example, the 11 letter word: 'ABRACADABRA'. 'A' occurs five times, 'B' & 'R' twice and 'C' & 'D' once. See Figure 4.

In 8-bit ASCII this would occupy 88 bits (we'll presume the length does not need to be encoded). We could encode the letters as a three bit character set and reduce the size to 33 bits. In BCU we could code 'A'=1, 'B'=01, 'R'=001, 'C'=0001, and 'D'=0000. This would reduce the size to $(1 \times 5 + 2 \times 2 + 3 \times 2 + 4 \times 1 + 5 \times 1) = (5 + 4 + 6 + 4 + 5) = 24$ bits. Notice that we don't need to termi-

| Decimal | Binary (3-bit) | Unary | Binary Coded Unary | Unary Prefixed Binary |
|---------|----------------|--------|--------------------|-----------------------|
| 0 | 000 | | 1 | 10 |
| 1 | 100 | 0 | 01 | 11 |
| 2 | 010 | 00 | 001 | 0100 |
| 3 | 110 | 000 | 0001 | 0110 |
| 4 | 001 | 0000 | 00001 | 0101 |
| 5 | 101 | 00000 | 000001 | 0111 |
| 6 | 011 | 000000 | 0000001 | 001000 |

NB: Reading left to right

Figure 1 - Binary and unary compared



```

static int getupcode(int occ[], int n,
                     int ul[])
{
    /* ENTRY >> occ[]:
       Number of occurrences of n items,
       sorted in descending order
    EXIT >> ul[]:
       Number of bits in suffix of each
       of (returned) prefix codes */

    int total, /* Total occurrence of
                current and as yet
                unallocated items */
        item, /* Item */
        oc, /* Occurrence of item(s)
              to be allocated to
              current unary prefix */
        u, /* Index of current unary
              prefix */
        i; /* General index */
    /* Get total occurrence of all items */
    for (total=0; i=n; i--; total+=occ[i])
        ul[i]=0; /* Reset UP lengths */
    /* For each prefix, until all processed
       (maintain total of unallocated ocs) */
    for (u=item=0; item<n; ++u, total-=oc)
        /* Extend suffix until ocs exceed half
           remainder (oc>(total-oc)/2) */
        for (oc=occ[item++]; oc*3<=total;
             ++ul[u])

```

```

    /* Accumulate ocs of other half of
       items in extended, suffix group */
    for (i=1<ul[u]; i--;
         oc+=occ[item++]);
    /* Combine final suffixes
       of equal length */
    while (u>1 && ul[u-1]==ul[u-2])
        /* decrementing number of prefixes and
           doubling items in penultimate
           suffix group */
        ++ul[~u-1];
    /* Return number of unary prefixes */
    return(u);
}

```

Figure 2 - The C function getupcode()

```

/* Demonstration of Unary Prefix Code */
/* by Crosbie Fitch */

#include <stdio.h>

#define DIM(A) (sizeof(A)/sizeof(*(A)))
static int item_occ[] = {11, 6, 5, 5, 4, 4, 3, 3,
                        3, 3, 2, 2, 2, 2, 1, 1, 1};

#define MAXCODEN DIM(item_occ)
static int getupcode(int [], int, int []);

```

```

int main(void)
{
    static int upcode[MAXCODEN],
              upcoden;
    int i, j;
    upcoden = getupcode(item_occ, MAXCODEN,
                        upcode);
    for (i=0; i<upcoden; ++i)

```

```

        for (j=i; j-->0;
             putchar('0'));
        if (i<upcoden-1)
            putchar('1');
        for (j=upcode[i]; j-->0;
             putchar('x'));
        putchar('\n');
    }
    return(0);
}

```

Figure 3 - A C program to test getupcode()

inate the code for 'D' since the decoder will know that unary 4 is the largest code used. In UP code we'd use 'A'=1, 'B', 'R', 'C' & 'D'=0xx. This gives a size of $(1x5+3x(2+2+1+1)) = (5+3x6) = 23$ bits. Again, the last code's prefix doesn't need to be terminated. In Huffman code we'd use 'A'=1, 'B'=00, 'R'=010, 'C'=0110, 'D'=0111. This gives a size of $(1x5+2x2+3x2+4x1+4x1) = (5+4+6+4+4) = 23$ bits.

UP code often gives very close performance to that of Huffman code, in fact it has to be a carefully contrived example that displays a marked difference.

How to do it

Although I haven't got the space for details about how to write routines to compress and decompress files using UP Code, I will provide you with the critical routine to calculate the number and lengths of UP codes. It is fairly straightforward to pursue the idea further from this point.

Figure 2 is of the C function getupcode(). This takes as input a sorted array of occurrence counts. It returns an array of suffix lengths. Figure 3 is of a demonstration program which will out-

put a list of UP codes resulting from a particular list of occurrence counts. Given the ABRACADABRA example, {5,2,2,1,1}, it would produce:

1
0xx

The zeros and ones make up the unary prefix and the xs indicate the binary suffix. Figure 3 is based on the frequency counts in the example from the Sedgewick book. It produces the output shown in the first column of Figure 5.

Note that the codes are allocated in unary order to the items in sorted occurrence count order. Thus the first item, occurring 11 times, is given the code 100; the 2nd of 6 times, 101; 3rd of 5, 110; and so on. The encoded text would start off 01011000110110...

The reason UP code isn't as optimal as Huffman code is that UP code restricts the size of suffix groups to be a power of two. Huffman code can have totally irregular suffixing. Thus, instead of having to have four 3-bit codes, as in '1xx', Huffman code can use codes 100, 101xxx and 11x, three 3-bit codes, using the fourth as a prefix for a longer group.

I'd recommend UP code for high speed situations where there is no requirement for optimal compression of large files. To decode, all it requires are simple bit shift operations that increment an index into an array of suffix lengths and corresponding indices to the original items. Incidentally, if speed is paramount, it might be preferable to leave the termination bit on the last prefix.

A trick that might help decoding is based on the idea of first extracting the unary prefix, using the formula

Prefix =
UPCode & (~UPCode + 1)

For example, if the UPCode is 001xx, which is stored 'back to front' as bbbxx100, then we have:

Prefix
= bbbxx100 & (BBBXX011+1)
= bbbxx100 & BBBXX100
= 00000100

The prefix may then easily be determined by comparison or shifting to zero, eg

while (x>>=1) ++count;

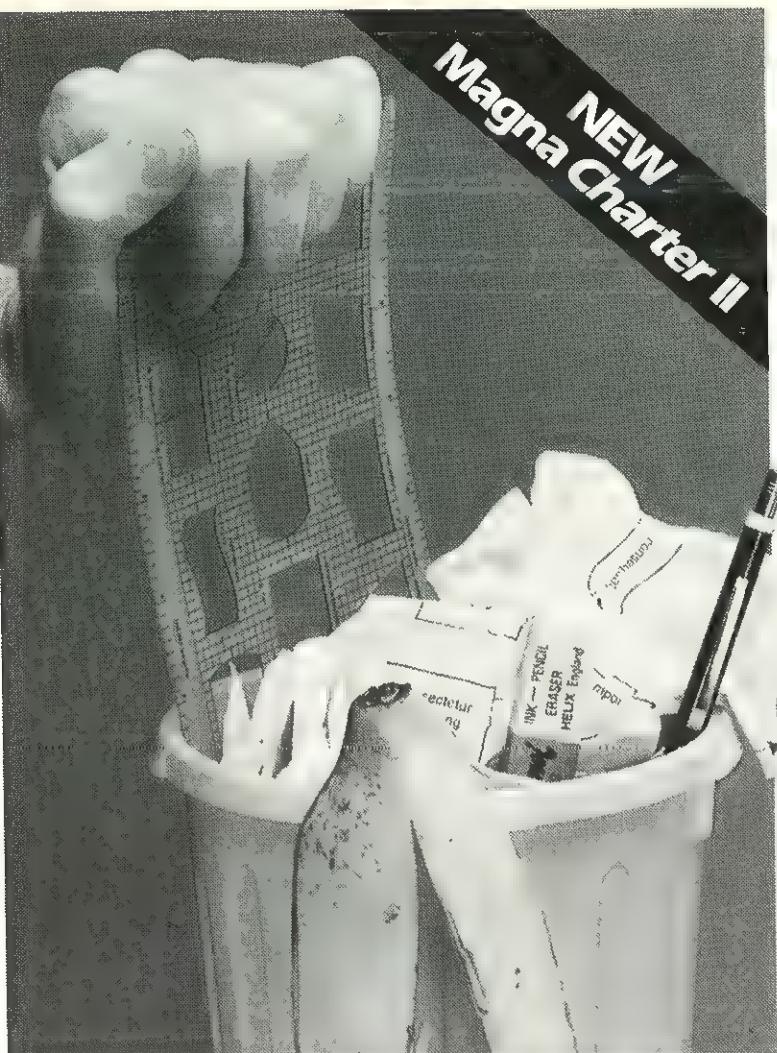
Alternatively, if you have memory to spare, you can create a look-up table of values for each possible prefix signature.

| Item | ASCII | 3 bits | BCU | UP Code | Huffman Code |
|------------|-------|--------|-----|---------|--------------|
| A = 5 x | 8 | 3 | 1 | 1 | 1 |
| B = 2 x | 8 | 3 | 2 | 3 | 2 |
| R = 2 x | 8 | 3 | 3 | 3 | 3 |
| C = 1 x | 8 | 3 | 4 | 3 | 4 |
| D = 1 x | 8 | 3 | 5 | 3 | 4 |
| Total bits | 88 | 33 | 24 | 23 | 23 |

Figure 4 - Comparison of encoding ABRACADABRA

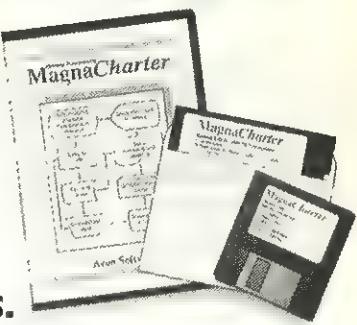
| Test String: A SIMPLE STRING TO BE ENCODED USING A MINIMAL NUMBER OF BITS | | |
|--|-------------|---------|
| UP Code | Occurrences | Letters |
| 1xx | 11,6,5,5 | I,E,N |
| 01xx | 4,4,3,3 | M,S,A,B |
| 001xx | 3,3,2,2 | O,T,D,G |
| 0001x | 2,2 | L,R |
| 00001 | 2 | U |
| 000001x | 1,1 | C,F |
| 0000000 | 1 | P |

Figure 5 - UP Code details of a test string



Out with the Old In with the New

MagnaCharter II
relieves the pain
of drawing charts.



MagnaCharter was one of the success stories of 1990. **MagnaCharter II** is the latest version of this much acclaimed product — for Microsoft Windows 3. Based on the spreadsheet principle, **MagnaCharter II** lets you build any kind of chart in minutes rather than hours and includes all the standard flowcharting symbols. Use the "crowsfeet" for database diagrams.

MagnaCharter II divides the screen into cells, identified by a double mouse click or keyboard entry into which symbols are placed. All available symbols are displayed as icons — or add your own. The various features are accessed via drop down menus, dialogue boxes and multiple windows with a wide range of text styles and sizes available. Editing is by simple cut-and-paste techniques and links between symbols can be "auto" or "conditional". **MagnaCharter II** supports PostScript output and a wide range of printers. Through the Clipboard, pass bitmaps, metafiles and text.

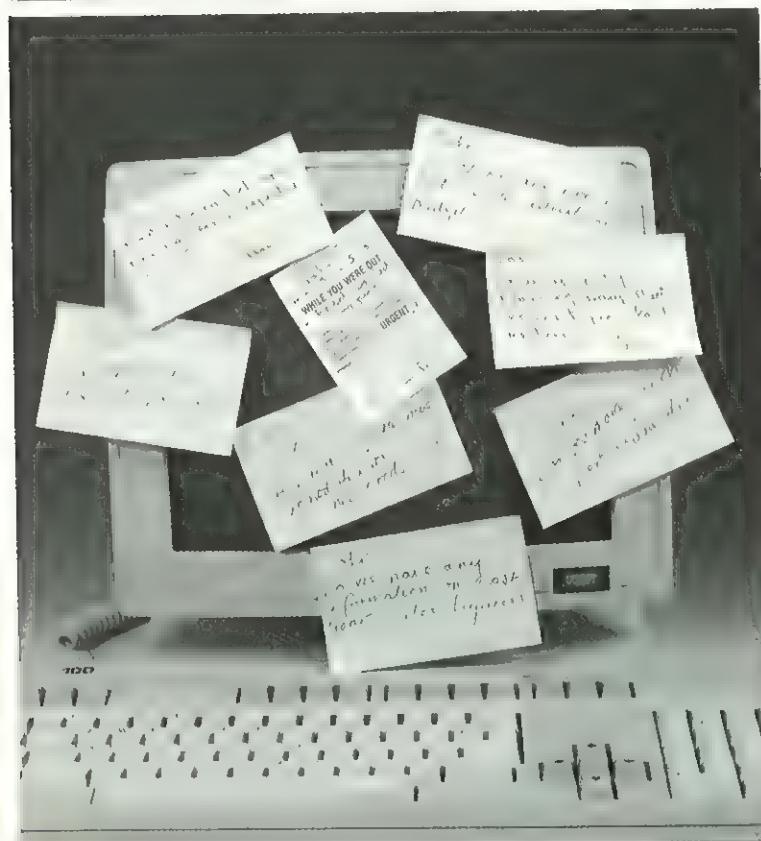
MagnaCharter II supports Windows 3 (**MagnaCharter** 1.03 is still available for DOS). Published by Systemstar, **MagnaCharter II** is available for £160 excluding VAT and P&P. Price includes a complete manual and examples to help you achieve professional results fast.

Order yours today by contacting Systemstar on (0992) 500919.



1-3 Parliament Square, Hertford, SG14 1EX
Telephone: (0992) 500919 Facsimile: (0992) 554261

CIRCLE NO. 561



The Key Word is **SNIPPETS**™ — the information manager.

SNIPPETS is the answer for those with a busy mind, cluttered desk, long action lists, research data, estimates . . . indeed anyone who wants to enter and store free format text, and retrieve it quickly and easily at the touch of a key. All this is done via pop-up menuing, an on-line Help system and powerful text searching facilities.

To share information, a multi-user version of **SNIPPETS** is available. You can select what information is private and what is to be shared. **SNIPPETS** provides a corporate information system with password protection and even a privacy hot-key.

Facilities in **SNIPPETS** include: — Text searching, on single and concatenated strings. TODO — The ability to mark a document to build an action list. Printing, Import and Export — Documents can be imported and exported and interfaced with other software, eg word processing.

SNIPPETS can be learnt in minutes and does not require knowledge of data files, fields and other computing jargon. **SNIPPETS** is available with manual and tutorial for MSDOS and CDOS and most DOS LANs. Prices are single user — £175 + VAT, multi user — £625 + VAT.

SNIPPETS is a British product of Valeburn Software and is distributed and supported by Systemstar. For more information or a demonstration disk, contact Systemstar on (0992) 500919.



1-3 Parliament Square, Hertford, SG14 1EX
Telephone: (0992) 500919 Facsimile: (0992) 554261

CIRCLE NO. 598

Prologue data

One area in which UP Code is more efficient than Huffman Code is that of encoding information about the encoding key. Both methods also have to supply details of what each code represents, but since that is the same for both, I won't describe it here.

Huffman Code must supply details of the binary coding tree. Since it is a binary tree it can be represented in binary too, using a bit for each node. A zero bit indicates a leaf and a one bit indicates a branch. The coding tree needed to encode "A SIMPLE STRING..." requires 18 bits for the leaves and 17 bits for the branches; a total of 35 bits. Note that this tree will also reveal how many different codes there are.

UP Code needs only to supply the suffix lengths to each unary prefix. An initial value declares the number of prefixes (-1) which follow in BCU. I suggest the use of regular Unary Prefixed Binary (UPB) for this first value. UPB is an equal number of bits used for both unary prefix and binary suffix, and so progresses: 0..1=1x, 2..5=01xx, 6..13=001xxx, etc. Figure 6 shows how the UP Code list has been encoded. This gives a length of 21 bits.

If N is the number of different items encoded, then the encoding information size E is constant for Huffman Code at $E = 2N-1$ bits. Unfortunately, there is no simple formula for that of UP code (using my method). Even so, I estimate that E varies between $3+Log_2(N)$ bits and $3+N+2Log_2(N)$ bits. With $N = 18$, as in the preceding example, E could actually vary from between 9 to 28 bits. Anyway, if we're dealing with small file sizes, the bits saved in the header of UP Code can often make up for the bits lost in the non-optimal coding. If we had the same frequency distribution as in the example, it would take a file size of about 840 items (as opposed to 60) before Huffman Code becomes more compact (a difference of one bit every 60 items).

One final point to mention: you may decide you prefer BCU with 1s as digits and 0s as terminators. Thus instead of 1, 01, 001 and 0001 you have 0, 10, 110 and 1110. This way the sum of the digits accords with the value. My justification for using it the other way around is to continue with the pattern of the highest valued digit being the base-1. Decimal 0Ah - 1 = 9, octal 8 - 1 = 7, binary is 2 - 1 = 1, so I thought unary should be 1 - 1 = 0.

| UP Code prefixes | Encoded |
|------------------|---------|
| 6 (n-1) | 001000 |
| 1xx | 001 |
| 01xx | 001 |
| 001xx | 001 |
| 0001x | 01 |
| 00001 | 1 |
| 000001x | 01 |
| 000000 | 1 |

Figure 6 -
Encoding the UP Code list

I hope this has been of interest. If I haven't persuaded anyone of the merits of Unary Prefix Code, I'd be happy to think that at least some people have had the idea knocked out of them that Huffman Code is the only useful, variable length, binary encoding scheme.

EXE

Crosbie Fitch has worked as a C programmer for the Institute of Manpower Studies for the last six years. He is a fan of RISC computers, such as the Acorn Archimedes, and contributes to various Acorn related journals.

Intelligence Test Part IV

You have finished the bulk of your work for today, and have a few minutes in hand. Do you use your copious free time

- a) To play game after game of Windows Solitaire?
- b) To polish up the in-depth documentation that you always produce for your programs?
- c) To learn the Ada reference manual?
- d) To use your in-depth expertise to put together an in-depth article for .EXE, the in-depth programmers' magazine, in the fully and happy knowledge that, if your work is published, you stand to gain a generous fee, running to many hundreds of pence sterling?

Ratings: a) nerd, b) creep, c) loony and d) thoroughly together, well-balanced and likeable person.

If you are a thoroughly together, well-balanced and likeable person, why not contribute to .EXE Magazine? Over the coming months we will be having thematic issues on...

- Algorithms
- Windows
- Database design and Client/Server architecture
- Third part libraries
- The Macintosh

If you have an idea for a fab article on these (or any other .EXEish topic) write for a copy of our Contributors' Notes to:

The Editor
.EXE Magazine
10 Barley Mow Passage
Chiswick, London W4 4PH

PS: We are also seeking contributions to our columns - especially Soapbox & IC.



When is it nuts
to write your own
real-time kernel?



The core of great real-time solutions.

Leylands Farm, Nobs Crook, Colden Common,
Winchester, Hampshire. SO21 1TH. England.
Telephone: 0703 601990 Facsimile: 0703 601991.

CIRCLE NO. 564

Today's real-time executive kernels and full operating systems have soared far beyond the primitive code of even a few years ago.

And the explosive growth in real-time automation, robotics, communications, education, engineering and scientific solutions ensures that they're set to go on soaring.

To write your own kernel or operating system in house not only involves you in tens of thousands of pounds and up to 2 man-years work by scarce programmers, but will probably be inflexible, difficult to upgrade, untransportable to other hardware platforms, hard to debug and test, lacking in development toolsets to name but a few.

Microware are one of the longest-established software houses in the world, and for almost 15 years have concentrated on the development of the most intelligent real-time executive software available.

Now their OS-9, and latest platform-independent OS-9000, have become the industry standard in real-time software. Here's what you get:

- Major development time and cost saving.
- Built-in reliability.
- A range of add-on I/O, storage and memory features.
- Powerful, compact built-in functions.
- Future-proofing.
- A complete development environment and bridges to other operating systems.
- Full documentation.
- Portability.
- Easier testing and far less debugging.
- Widely experienced technical support.

Add all that up, compare it with the REAL cost of an in-house DIY job, and then have another look at the headline.

99 times out of 100, right?

Please rush me details of Microware's OS-9 and OS-9000 series, as designing my own operating system is driving me nuts!!

Name: _____

Title: _____

Company: _____

Address: _____

_____ Tel: _____

Please return to address opposite.

EXE 3/92

The Fastest Draw

*Which C compiler is the best for writing DOS graphics applications?
Cliff Saran assesses five contenders.*

If you want to produce respectable DOS graphics on a shoe-string budget, check what your compiler has to offer before considering third party libraries. This month I have been investigating the strengths and weaknesses of the five graphics libraries bundled with Borland C++ V3.0, Microsoft C V6.0, Topspeed C V3.0, Watcom C V8.5 and Zortech C++ V3.0.

How different are these libraries? How fast are they and what's it like to write code using them? The short answer is that they all offer similar capabilities. What's more, three of these libraries (from Microsoft, Topspeed and Watcom) provide more or less source code compatibility with each other. To make life easier, I'll refer to this trio as the Microsoft compatible libraries. In Figure 1, I have compiled a list of features supported by the five libraries.

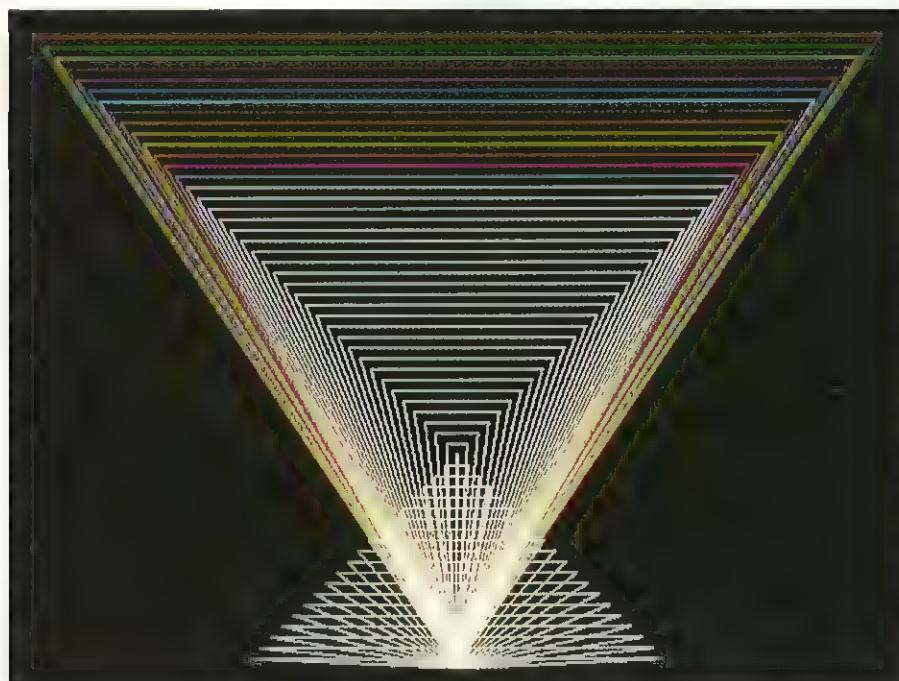
When attempting to produce a meaningful comparison between several libraries it is impossible to provide a definitive set of tests that reflects their complete functionality. I have opted for testing the subset which I consider to be the most likely graphics functions that an 'average punter' would want to use. There is obviously a strong element of personal judgement in this choice of functions, but I believe that my benchmark is a fair indication of the performance and functionality provided by these five libraries. The results of the benchmarks are given in

Figure 2. For a description of the benchmarks see the separate box.

Underlying BGI is the concept of a hypothetical graphics cursor which moves in response to various calls to the library. Lines can be specified either uniquely (ie providing both end-points) or from the current cursor position. Borland allows you to change the appearance of a line in two ways. You can specify both the thickness of a line and the way in which it is drawn (ie Solid or Dashed). There are four built-in line patterns and you can also specify one of your own. When drawing shapes, such as rectangles and polygons, Borland uses the current settings for both the colour and the line style so the settings remain in force until they are changed.

Circular shapes (ie ellipses) are defined by specifying a centre and a radius. Arcs and sectors additionally require a Start and End angle in degrees. Borland's approach to defining these shapes is extremely 'user-friendly' and it maps easily onto the way we usually picture them mathematically (see Figure 3).

There are several built-in fonts which Borland provide for writing to the graphics screen. The Stroke-based fonts are character-sets specified with vectors, making them extremely easy to scale. The bitmap-based fonts are aesthetically better to look at than stroked-based characters, but these characters cannot easily be scaled. Borland provides one bitmap font and 10 stroked fonts. User-defined stroke-based characters can



Borland BGI

The function call required to initialise Borland's BGI engine is a little intimidating.

```
void initgraph
{
    int far *graphdriver,
    int far *graphmode,
    char far *pathodriver
}
```

This complexity is due to the immense versatility that Borland has built into the library ie it is possible to load your own custom graphics card driver into the BGI library (the BGI driver spec is available from Borland). Although Borland provides drivers for the standard CGA, EGA and VGA graphics modes, there are several SVGA drivers available in the public domain from such places as the Borland conferences on CIX and CompuServe, and also various commercial third party offerings.

YOUR ONE-STOP SOURCE FOR THE LATEST TOOLS AT THE BEST PRICES

PRE-SALE
CONSULTING

POST SALE
SUPPORT

NEW & NOTEWORTHY

| | |
|---|------|
| ABC Flowcharter v1.1 for Windows | £139 |
| Priced to go. Get yours now! | |
| Baler v5.1 | £99 |
| Only a few left, priced to go! | |
| Borland C++ v3.0 & App. Frameworks | £289 |
| Unsurpassed DOS & Windows development environment with ready-made user interface objects. | |
| BRIEFFor C++ | £75 |
| Cardinal 9600 MNP-5 V.32 Modem | £265 |
| 9600 baud, MNP-5, V.32 operation, V.42 compatible INCREDIBLE VALUE! | |
| Corel Draw v2.0 CD-ROM | £319 |
| GRASP with AR TOOLS v4.0 | £159 |
| Complete control over all aspects of Graphics Animation and Presentation. | |
| Laplink Pro, v4.0 | £65 |
| Limited time offer. Get yours while supplies last! | |
| MS OS/2 Presentation Mgr Toolkit v1.2 | £239 |
| Priced to move, only a few remaining. | |
| MS QuickC/Windows & Windows SDK | £309 |
| Multi-Edit v6.0 | £65 |
| New Version! | |
| Object Vision v2.0 | £69 |
| Create full-fledged Windows applications without programming. | |
| Paradox v3.5 with DeskTop | £145 |
| Limited time offer 'till 31/03/92 | |
| Photofinish | £45 |
| Pizazz Plus v3.0 | £49 |
| Screen Capture, Print & Export Utility | |
| A 'must' for Desktop Publishing! | |
| RPG II Development System v4.0 | £999 |
| New version. | |
| Show PArtner F/X v.3.6 | £179 |
| Presentation and Animation, free Runtime SoundBlaster Pro | |
| SoundBlaster Pro | £165 |
| Multimedia is not coming...it's here! | |
| Music, Speech, MIDI, CD-ROM Interface, Spontaneous Assembly v2.0 | £85 |
| Priced to go, only a few left! | |
| Stacker v2.0 | £69 |
| Double your hard disk capacity! | |
| Turbo C++ for Windows | £75 |
| Includes Resource Workshop, Graphical tools speed up & simplify Windows dev't. | |
| TURBO VISION DEV TOOLKIT v2.0 | £85 |

ARTIFICIAL INTELLIGENCE

| | |
|-------------------------------------|------|
| Arity Windows Toolkit v6.0 | £189 |
| Arity/Prolog Advanced Toolkit v6.0 | £85 |
| Arity/Prolog Compiler & Interpreter | |
| Arity/Prolog Interpreter v6.0 | £169 |
| Arity/Standard Prolog v6.0 | £55 |
| PC Scheme v3.03 | £59 |
| PC Scheme v3.03 | £59 |
| PDC Prolog v3.7 | £179 |
| VP-Expert v3.0 | £154 |

ASSEMBLERS & LINKERS

| | |
|-------------------------------------|------|
| ASM Tools v2.5 | £109 |
| Phar1 apt 386 DOS Extender SDK v4.0 | £225 |
| Phar1 apt 386/ASM/LinkLoc v4.0 | £799 |
| Source486 | £79 |
| Turbo Debugger & Tools v2.0 | £75 |

BASIC

| | |
|----------------------------|------|
| dbLIB Database Library | £65 |
| GraphPak Professional v3.0 | £89 |
| Microsoft Visual Basic | £89 |
| PowerBASIC | £59 |
| QuickPak Pro v4.0 | £119 |
| Stay-Rcs Plus 4.0 | £125 |
| True Basic v3.02 | £59 |

BUSINESS

| | |
|----------------------------------|------|
| ABC Flowcharter v1.1 for Windows | £139 |
| Baler v5.1 Spreadsheets Compiler | £99 |
| GrammaLink v2.0 for Windows | £45 |
| Micrografx Charisma v2.1 | £249 |
| ORG PLUS Advanced v6.0 | £49 |
| Super Project v2.0 for Windows | £410 |
| Who-What-When v2.0 | £140 |

C AND C++

| | |
|------------------------------------|------|
| Aztec C 86-p Professional System | £125 |
| Borland C++ v3.0 | £195 |
| Borland C++ v3.0 & App. Frameworks | £289 |
| C ASYNCH MANAGER v3.1 | £99 |
| C Communications Toolkit | £85 |
| C TOOLS PLUS v6.0 | £79 |
| C Utility Library | £129 |
| C+Views | £239 |
| C-terp v3.5 | £159 |
| C-Worthy v2.0 & cW Architect | £149 |
| CLEAR for C | £89 |
| Codebase 4.5... | £125 |
| Essential Communications | £169 |
| Greenleaf Comm+1 | £99 |
| Greenleaf Functions Library v4.02 | £119 |
| Greenleaf ViewComm 3.0... | £205 |
| Informix ESQ/LC... | £295 |
| Intel 386/486 C Code Builder Kit | £319 |
| Microsoft Quick C for Windows | £85 |
| MPW C++ v3.2... | £149 |
| MS Programmer's Library (CD-ROM) | £185 |
| NDP C-486 v3.2... | £745 |
| Paradox C Engine v2.0... | £73 |
| PC-Lint v5.0... | £159 |
| POWER TOOLS PLUS | £79 |
| TopSpeed C Master edition | £275 |
| TopSpeed C Professional v3.02 | £165 |
| TopSpeed C Professional edition | £165 |
| TopSpeed C++ Standard | £110 |
| TopSpeed C++ v3.02... | £50 |
| Turbo C TOOLS v6.0... | £79 |
| Turbo C++ 2nd Edition | £49 |
| Turbo C++ for Windows | £75 |
| TURBO VISION DEV. TOOLKIT v2.0... | £79 |
| Vitamin C v4.0 | £219 |
| WATCOM C 8.5... | £269 |
| WATCOM C 8.5/386... | £465 |
| WIN++ v2.1... | £139 |
| WindowsMaker v3.07 | £469 |
| Zinc Interface Library for DOS | £139 |

| | |
|--------------------------------------|------|
| Zinc Interface Library for DOS & Win | £199 |
| Zortech C++ Database Class Library | £189 |
| Zortech C++ v3.0 for DOS, Win & OS/2 | £199 |

| | |
|----------------------------|------|
| CADD | |
| AutoSketch v3.0 | £49 |
| Design CAD 3D | £149 |
| DRAFX CAD v2.0 for Windows | £319 |
| Generic CADD 3D v1.1 | £169 |
| Generic CADD v6.0 | £219 |
| MathCad v3.0 for Windows | £225 |

| | |
|-------------------------------|--------|
| CASE | |
| Case PM for C and C++ | £1,245 |
| Case: W Corporate v3.1 | £620 |
| Case: W Standard Edition v3.0 | £309 |
| Competitor v1.11 | £129 |

| | |
|---------------------------------|--------|
| EasyCASE Plus v3.0 | £299 |
| EasyCASE Professional Pack v3.0 | £399 |
| System Architect | £1,099 |

| | |
|--------------------------------------|------|
| COBOL | |
| LPI COBOL Compiler for DOS | £799 |
| RM/COBOL v1. Development System v5.1 | £599 |
| RM/COBOL-85 Developer Pak + | £935 |
| RM/COBOL-85 v3.1 Deployment Pack | £75 |

| | |
|----------------------------------|------|
| COMMUNICATIONS | |
| Carbon Copy Plus v6.0 | £85 |
| Central Point Commute | £55 |
| CrossTalk Communicator v2.0 | £29 |
| CrossTalk v1.7 for Windows | £89 |
| CrossTalk XVI | £89 |
| Greenleaf CrossTalk v3.2 | £185 |
| HyperACCESS v5.2 | £49 |
| pcAnywhere IV v4.5 Host & Remote | £89 |
| Procomm Plus v2.01 | £49 |
| Reflection I + for DOS | £219 |
| Remote2 v2.1 Host & Caller | £79 |
| SmartTerm 420 for Windows | £125 |
| View 232 v1.1 | £109 |

| | |
|--|----------------------|
| DATABASE & FILE MANAGEMENT | |
| Advanced Revelation v2.1 | £539 |
| ALPHA/Four v2.0... | £75 |
| ALPHA/Four v2.0 Competitive Upgrade | £75 |
| B-Tree Filter v5.2 | £79 |
| Btree v5.1 for DOS, Win or OS/2 | £299 |
| c-tree Plus v6.0 | £39 |
| Clarion Personal Developer v2.0 | £35 |
| Clarion Professional Developer v2.1 | £349 |
| CLEAR+ for dBASE | £89 |
| Data Boss | £345 |
| DataEase v4.5 | £399 |
| DataFlex Multiuser Devlpt System v2.3 | £510 |
| db4st/Windows v1.5 | £205 |
| FarCom Toolbox Special Edition v2.0... | £419 |
| FUNCky LIB... | £125 (PLEASE CHECK!) |
| Genie... | £175 |
| Informix 4GL Compiled | £489 |
| Informix SQL | £389 |
| Novell Xirvice Plus v4.1 | £490 |
| Oracle Tools & Database v6.0 | £859 |
| Paradox C Engine v2.0 | £75 |
| Paradox v3.5 Competitive Upgrade | £139 |
| PC/Focus v6.0 with Perspective Jr. | £375 |
| R&R Code Generator | £99 |
| R:BASE v3.1 | £359 |
| zylINDEX for Windows | £185 |

| | |
|-----------------------------------|------|
| DEBUGGERS | |
| Multiscope Debugger for DOS v1.02 | £89 |
| Multiscope Debugger for Windows | £189 |
| Periscope Debuggers | CALL |
| Turbo Debugger & Tools v2.0 | £75 |

| | |
|-------------------------------------|------|
| DESKTOP PUBLISHING | |
| Adobe Type Manager for Windows | £46 |
| Adobe Type Manager Plus for Windows | £93 |
| Aldus PhotoShop for Windows | £399 |
| Facelift v1.2 for Windows | £45 |
| Freedom of the Press Windows | £179 |
| Go Script Plus | £145 |
| Inset v2.2... | £79 |
| Legacy v2.0... | £109 |
| Microsoft Publisher for Windows | £95 |
| OmniPage 386 v3.1 for Windows | £325 |
| WordScan | £69 |

| | |
|------------------------------------|------|
| DISK/DOS/BACKUP | |
| Above Utilities for Windows | £45 |
| Back-It v4.1... | £59 |
| Central Point Backup v7.0 | £55 |
| Disk Technician Gold v1.04 | £79 |
| Master Tracks Pro 3.95 for Windows | £199 |
| Norton Utilities v6.01 | £39 |
| PC Tools Deluxe v7.1 | £75 |
| PC-Kwik Powerpak v2.1 | £59 |
| Q-DOS 3.1 v.5... | £35 |
| SpeedStar v6.0... | £49 |
| SpinRite II | £49 |
| Super PC-Kwik v4.1 | £35 |
| Voppli... | £35 |
| XTree Pro Gold | £75 |

| | |
|---------------------------------|------|
| EDITORS | |
| BRIEF v3.1 | £148 |
| Efax for DOS or OS/2 | £109 |
| EDT v5.0... | £165 |
| Editor for DOS, OS/2 or UNIX | £159 |
| KEDIT v4.0 for DOS & OS/2 | £95 |
| KEDIT v4.0 for DOS & OS/2 | £95 |
| Multi Edit Professional v6.0... | £99 |
| Qedit Advanced v2.1 | £39 |
| VERDIT Plus v3.5 | £99 |

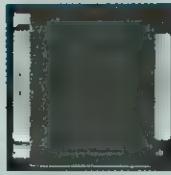
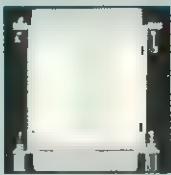
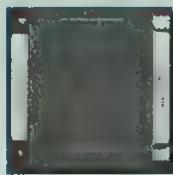
| | |
|--------------------------------|------|
| FORTRAN | |
| Consol... | £79 |
| FortLIB v6.0... | £149 |
| Fortran Toolkit 1 v5.2 | £65 |
| Fortran Toolkit 2 v5.2 | £99 |
| GRAFMATIC & PLOTMATIC | £129 |
| Lahey F77L | £355 |
| Lahey F77L v5.01 - EM/32 v4.02 | £595 |

| | |
|--------------------------------|----------------------|
| GRAPHICS | |
| Corel Draw v2.0... | £279 |
| Cricket Graph v1.4 for Windows | £59 |
| GDG Database Graphics v4.1 | £179 |
| Dr HALO IV Paint & Imaging Pak | £59 |
| FontWINDOW v4.1... | £289 (PLEASE CHECK!) |
| CRASP with ARTTOOLS v4.0... | £159 |
| GX EFFECTS v2.0... | £119 |
| GX Graphics... | £119 |
| GX Series Developers Pak | £469 |
| Hijack v2.1 | £89 |
| Insect Plus Hijack | £119 |
| MetaWINDOW v3.7 | £179 |
| MetaWINDOW/PLUS v3.7 | £239 |
| PCX Programmer's Toolkit v4.02 | £149 |

| | |
|-----------------------------------|------|
| HARDWARE | |
| 1Mb 80ns SIMM Memory Upgrade | £49 |
| Cardinal 2296 V.42 Fax Modem | £133 |
| Cardinal 2450 V.42 MNP Modem | £105 |
| Cardinal 9600 MNP-5 V.42 Modem | £285 |
| Cyrax 8387-33 Math Coprocessor | £149 |
| Intel 80387 DX Math Coprocessor | £109 |
| Intel SIMM 72 Pin 1Mb Memory PS/2 | |

SOFTWARE PROTECTION!

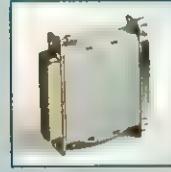
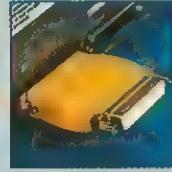
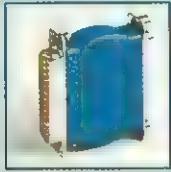
Can You Spot The Difference?



- High-level security keys**
- Assembler-based, customer specific, encrypted interrogation routines**
- Over 140 language interfaces available**
- Compatibility - due to 9 years experience & 750,000+ keys sold**
- Reliable on-going support**

- Physically unique keys for each customer**
- MS-DOS, OS/2, UNIX, XENIX, WINDOWS 2 & 3, 'MACINTOSH'**
- Transparent operation with most peripherals on market**
- Free language updates**
- Parallel, Serial, Mac ports**

OVER 4,000 CUSTOMERS WORLDWIDE HAVE!



Electronic Key

The ideal device for identically produced software packages. Uniquely wired with customer code and a software code. Uses Assembler based program, decryption interface and random values.

1 Word Memory Key

Custom hardware wiring allows the developer total control over information stored in the key. 2 bytes of memory allows several packages to be protected with just the one key.

31 Word Memory Key

For multiple software protection schemes. 31 words of 16 bits of non-volatile dynamically programmable memory. Its capacity to store information provides virtually limitless power. Flexible protection scheme can be modified on-site during operation of software package.

UP3 Memory Key

Provides the ultimate in software security. Not tied to any language or O/S. 8 bit microprocessor powers from RS-232 level. Requires no power supply. For PC terminals, minis, & others using RS 232 C comms. Used on workstations. This key is effectively a computer.

Macintosh Key

Extremely powerful & customised protection for the Mac. 31 words available for random storage. Providing unequalled protection the Macintosh Memory Key connects to the SCSI 25 pin port and operates transparently.



MICROPHAR *The European Leader**

* Based on the number of keys in use throughout Europe

Call us for more information or a demonstration package on

091-378 9191

CLEARSOFT,
Langley Moor, Durham DH7 8HG.
Telephone: (091) 378 9191 Fax: (091) 378 9393

Other European Countries

- * **FRANCE**, Tel: 33-1-47-38-21-21
- * **BELGIUM**, E2S (091 21 11 17)
- * **GERMANY, AUSTRIA**: (06223 - 73730)
- * **HUNGARY**, Polyware Kit (76-22-307)
- * **ITALY**, Siosistemi (030 24 21 074)
- * **PORTUGAL**, HCR (1 56 18 65)
- * **SPAIN**, Hal 2000 (032 37 31 05)
- * **SWITZERLAND**, SAFE (024 21 53 86)
- * **THE NETHERLANDS**, E2S (015 15 88 37)

| | Borland BGI | Microsoft | Topspeed | Watcom | Flash Graphics |
|-----------------------------|-------------------|-----------|----------|----------|--------------------|
| <i>Built-in Fonts</i> | 11 | 1 | 1 | 1 | 1 |
| <i>Compatibility</i> | BGI | MS | MS | MS | FG |
| <i>Fill Polygon</i> | Y | Y | Y | Y | Y |
| <i>Graphics Adapters</i> | VGA/HERC/IBM8514a | VGA/HERC | VGA/HERC | VGA/HERC | VGA/HERC/IBM8514a |
| | ATT400/PC3270 | | | SVGA | various SVGA cards |
| <i>Loadable font format</i> | BGI | .FON | - | - | Bitmaps only |
| <i>Mouse support</i> | N | N | Y | N | Y |
| <i>Num of lib calls</i> | 82 | 86 | 46 | 93 | 57 |
| <i>Viewport Clipping</i> | Y | Y | Y | Y | Y |
| <i>World Coördinates</i> | N | Y | N | Y | N |

Please note that VGA refers to CGA/EGA/MCGA/VGA compatible graphic cards.

Figure 1 - List of Features

also be loaded, and again, some are available in the public domain. However, BGI doesn't support standard Windows (.FON) fonts.

MS Compatible Libs

The Microsoft library provides a similar interface to Borland's. Initialisation is quite straightforward, `_setvideomode(mode)` is all that is required - but it suffers from less flexibility than the Borland approach. There is built-in support for CGA, EGA, Hercules and VGA, but that's all. You can't easily add an SVGA driver.

Like Borland, Microsoft also has an invisible graphics cursor that provides an anchor for drawing lines and moving to another position on the screen. However, there is no equivalent call to Borland's `line()` function which takes both end-points. You can change the style of the line from Solid to a user-defined pattern, although it isn't possible to vary the width of the line.

All the shapes in this library are characterised by an extra parameter which determines whether the interior of the shape should be filled. This has the advantage of reducing the number of library calls, while still providing the most efficient method to fill a given shape. For instance the following code extract will draw and fill a rectangle.

```
_rectangle (
  _GFILLINTERIOR,
  x1, y1, x2, y2
)
```

Microsoft differs significantly from Borland in the way that circular shapes are defined. When drawing an arc, you have to provide the end-points of two vectors that intersect the arc and this calculation requires a little floating-point arithmetic plus calls to `sin` and `cos` functions (see Figure 4).

Microsoft allows the programmer to set up both the origin and the size of a viewport that defines an area on the physical display which is used to output graphics. It is also

possible to define a new world-coördinate system which maps an arbitrary coördinate system onto the physical device coördinates (ie 640 by 480 pixels for VGA). This enables you to use 'real world' measurements in your graphics applications without having to convert them to device coördinates yourself. These measurements are floating point and Microsoft provides floating point versions of its drawing functions to take advantage of world-coördinates (Topspeed doesn't support this feature so it lacks the floating point graphics functions).

There is only one built-in font, and that's the system font. However, Microsoft does provide you with a mechanism to load .FON files which means that you can use any of the Microsoft Windows fonts - so there's no shortage of exotic fonts.

Zortech Flash Graphics

I found the Flash Graphics API less intuitive than either the Borland or the Microsoft offerings. There is no graphics cursor so all shapes require parameters for both the start and the end-point coördinates (ie there is no equivalent to the `moveto` library call). When you draw a line it is necessary to specify both end-points. The problem is that Flash Graphics uses an array to hold these parameters, so before you start any drawing, you have to set up such an array of coördinates and pass its address to the shape drawing function.

Although the library cannot cope with user-supplied graphics drivers, Flash Graphics directly supports several exotic graphics cards as well as the normal ones, including the Orchid Prodesigner, Paradise VGA Plus and Trident VGA cards. The `fg_init()` library call automatically obtains the highest resolution for your graphics display.

Unlike BGI or Microsoft, there is no way to set common attributes such as colour or line

| | Borland | Microsoft | Topspeed | Watcom | Zortech |
|---------------------|---------|-----------|----------|--------|---------|
| Clear Screen | 1.6 | 3.9 | 3.8 | 2.4 | 4.5 |
| Fill Polygon | 1.8 | 1.2 | 2.2 | 1.2 | 8.1 |
| FloodFill | 5.6 | 2.6 | 2.9 | 2.5 | 124 |
| Fill Block | 1.5 | 1.8 | 3.5 | 1.5 | 2.7 |
| Cycle Palette | 8.5 | 17 | 17 | 17 | 0.05 |
| Plot Pixel | 15 | 27 | 21 | 28 | 9.3 |
| Read Pixel | 18 | 20 | 9.3 | 22 | 8.8 |
| Draw Line | 2.6 | 2.7 | 3.5 | 3.7 | 4.8 |
| Draw relative Line | 1.8 | 1.7 | 2.3 | 2.9 | 2.5 |
| Draw Rectangle | 2.9 | 1.5 | 1.5 | 5.5 | 1.7 |
| Draw Polygon | 1.8 | 1.8 | 2.5 | 3.0 | 2.6 |
| Draw Circle | 6.0 | 2.3 | 4.7 | 3.2 | 6.1 |
| Draw Ellipse | 8.3 | 3.9 | 6.4 | 4.4 | 8.3 |
| Draw Sector | 2.3 | 1.3 | 2.8 | 2.8 | - |
| Draw Arc | 6.04 | 3.1 | 7.6 | 8.2 | 2.8 |
| Write Text | 2.2 | 5.1 | 3.5 | 5.2 | 3.1 |
| Xor Bitmap | 1.8 | 1.7 | 1.9 | 1.2 | - |
| Move Image | 4.5 | 5.9 | 15 | 4.5 | - |
| Copy Bitmap | 1.8 | 1.6 | 1.8 | 1.1 | 6.8 |
| Animation Demo | 6.7 | 6.7 | 6.4 | 4.7 | - |
| .EXE Graphics Index | 3.7 | 3.4 | 4.4 | 4.0 | 4.2 |

- Cannot be implemented directly
 All tests were measured in seconds using the `ANSI clock()` function.
 The Graphics Index is an indication of the overall performance for each library - a lower index implies a faster library.

Figure 2 - Graphics Libraries Benchmark

style. These parameters must be set up for each library call that produces graphical output (eg drawing lines or rectangles). There is also the question of the drawing mode. The two previous libraries provided a mechanism which allowed the programmer to change the way in which pixels were plotted (ie XORed with the background or SET) for all subsequent graphics calls. Since there is no common pool of attributes, in Flash Graphics this must be set for each library call. A Mask parameter, determining the colour planes onto which pixels are plotted is also required. Almost all of these parameters are needed to draw even the simplest of shapes such as a line, resulting in longer, more complicated function calls compared to the two previous libraries.

```
void fg_drawline
{
  fg_color_t colour,
  int mode, int mask,
  int line_type,
  fg_line_t line
}
```

As each shape in the Flash Graphics library contains enough information to redraw itself, it is easy to see how an object-oriented version of the library could be developed by encapsulating the whole library into a class library. This is exactly what Zortech has done with its FG class library which also comes with the compiler and provides a C++ interface to the Flash Graphics engine.

Flash Graphics uses the same concept as BGI when drawing circular shapes - you

Graphic Library Benchmark overview

The benchmark consists of 20 distinct tests which were run on a 40 MHz 386 with an Orchid Prodesigner II SVGA graphics card and no floating point co-processor. Each benchmark used the 640 by 480 16 colour VGA mode and was compiled for the small memory model with optimisation switched off. Where necessary, the benchmarks were repeated in a loop to obtain measurable timings.

All of the libraries provide a function to clear the graphics screen. *Clear Screen* gives an indication of how long this takes. The next group of benchmarks look at three ways to fill shapes. *FloodFill* and *Fill Block* are used to fill a rectangular area of the screen. *Polygon Fill* fills the interior of a triangle. *Cycle Palette* which increments the red, green and blue elements of the background colour. *Plot Pixel* writes a dot to each screen coordinate and *Read Pixel* reads them back. The next eight tests cover the built-in shapes (ie lines, vectors, rectangles, polygons, circles, ellipses, arcs and sectors). A fundamental requirement of any graphics library is the ability to place text on the graphics screen. Using the BIOS system font, *Write Text* places 16 lines of text on the screen. Finally there are the image handling tests. *Xor Image* and *Copy Image* copy a large rectangular block of the screen to another location using the logical Xor and Copy (ie replace) mode respectively. *Move Image* is a simplistic animation sequence in which a small rectangular bitmap flows smoothly down the screen. The finale is the *Animation Demo* which is a more demanding animation that uses several graphics library calls.

The Graphics Index in the last row of the benchmark table summarises all the results. This value was calculated by taking the geometric mean of the results for each of the five libraries. If interested in the test source code, please call the .EXE office.

only have to provide the radius and start/end angles (for Arcs). Unlike Borland, these angles are in the range 0 to 3600 which gives an accuracy of one-tenth of a degree (in Borland angles can only be specified in whole degrees).

As is apparent from the benchmark results of Figure 3, Flash Graphics doesn't have any library calls that draw sectors or manipulate bitmaps. This means that it is necessary to hand-code these functions ie

it is not as complete as either the Borland or the Microsoft libraries. However, unlike Microsoft, Flash Graphics does offer a degree of SVGA support.

Benchmark Results

There are a few points worth bearing in mind regarding the benchmark results in Figure 2. First, let me draw your attention to the speed of the Flash Graphics 'Cycle Palette' test. How does it manage to cycle

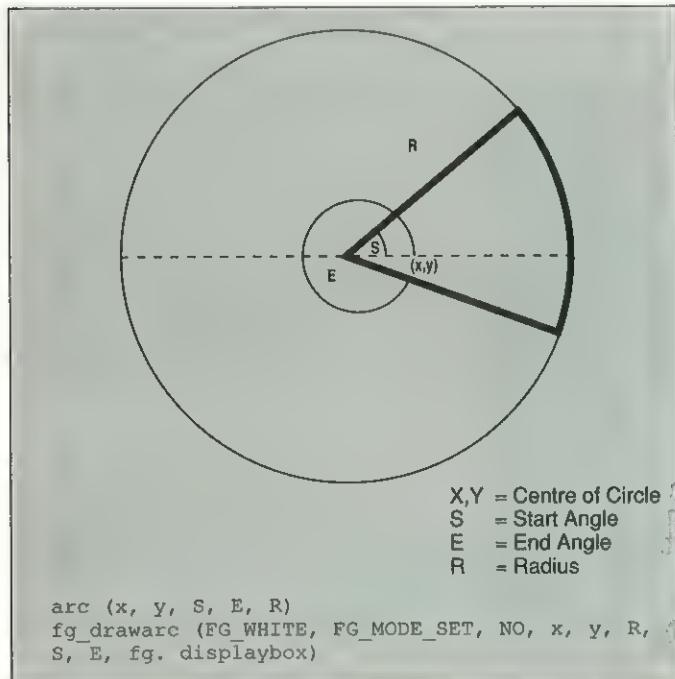


Figure 3 -
Arc drawing with BGI/Flash Graphics

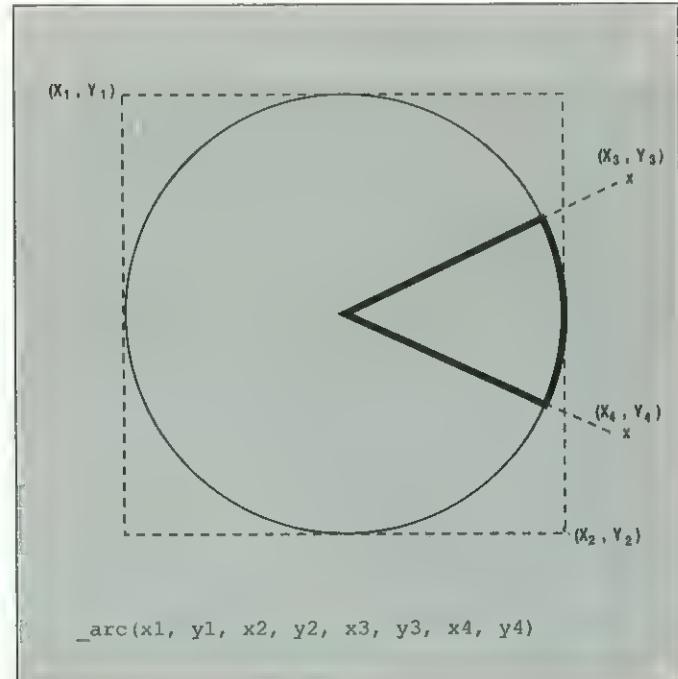


Figure 4 -
Arc drawing with Microsoft Graphics library

THE SOFTWARE CONSTRUCTION COMPANY

BORLAND

| | |
|------------------------|------|
| Borland C++ v.3.0 | £189 |
| C++/App. Framework | £289 |
| Turbo C++ 2nd. Edition | £45 |
| Turbo C++/Turbo Vision | £65 |
| Turbo C++ for Windows | £79 |
| Turbo Debugger & Tools | £85 |
| Turbo Pascal v.6.0 | £65 |
| Pascal Professional | £129 |
| Pascal for Windows | £99 |
| ObjectVision v.2.0 | £79 |
| Paradox 3.5 | £325 |
| Paradox Engine | £189 |
| dBASE III+ | £395 |
| dBASE IV | £419 |
| dBASE IV Dev. Ed. | £649 |

UK AUTHORISED

| | |
|--------------------------|------|
| COMMUNICATIONS LIBRARIES | |
| AdComm | £190 |
| Async Professional | £90 |
| ASYNCH PLUS | £125 |
| C ASYNCH MANAGER | £125 |
| C Comm Tkt Prof Ext DOS | £325 |
| C Comms Toolkit Prof. | £195 |
| C Communications Toolkit | £99 |
| Essential Communications | £215 |
| GET-IT | £99 |
| Greenleaf Comm++ | £129 |
| ProBas Telecom Toolkit | £49 |
| QuickComm | £99 |
| SilverClip SPCS | £225 |
| SilverWare C Asynch Lib. | £165 |
| Solid Link with source | £325 |

DATA FILE HANDLERS

| | |
|--------------------------|------|
| B+Tree Data Manager | £65 |
| B-Tree Filer | £90 |
| B-Tree Filer (multiuser) | £125 |
| BTREE/ISAM multi user | £115 |
| BTREE/ISAM single user | £75 |
| Btrieve for DOS | £385 |
| C++ Database Class Lib | £150 |
| C-Data Manager w/source | £385 |
| C-Index/II | £449 |
| C-ISAM | £215 |
| c-tree Plus | £385 |
| c-tree with r-tree | £419 |
| CBTREE | £129 |
| CodeBase 4.5 | £255 |
| CodeBase 4.5 Upgrade | £95 |
| db/LIB Database Prof Lib | £125 |
| BFtrieve | £115 |
| dp-MAX | £99 |
| E-Tree Plus | £165 |
| Essential B-Tree | £129 |
| EZedit Unlimited Users | £195 |
| Faircom Server | £190 |
| Phase One | £319 |
| Pinnacle Engine | £165 |
| POET | £259 |
| QBE/Phase 1 | £255 |
| Toolbox Professional | £835 |
| Toolbox Special Edition | £515 |
| Topaz - Multi-user DBMS | £99 |
| r-tree Report Generator | £190 |

GENERAL FUNCTIONS

| | |
|---------------------------|------|
| "C"erious Toolkit Plus | £65 |
| 3PX Extended Function Lib | £129 |
| BASIC Development Tools | £65 |
| Blackstar C Function Lib | £65 |
| C TOOLS PLUS | £99 |

| | |
|---------------------------|------|
| C Utility Library | £165 |
| dBUtility Library | £100 |
| FUNCky.LIB | £175 |
| Grumpfish Library | £129 |
| Object Professional | £125 |
| ProBas Prog. Library | £115 |
| ProBas Toolkit | £85 |
| QuickPak Professional | £129 |
| Rogue Wave C++ Class Lib. | £59 |
| Soft.Clip (Net. version) | £195 |
| Spindrift Library | £99 |
| Spontaneous Assembly | £129 |
| SuperLIB Prof. Network | £155 |
| SuperLIB Professional | £129 |
| SuperFunctions | £195 |
| Tools.h++ | £129 |
| Turbo Professional | £89 |

GRAPHICS LIBRARIES

| | |
|--------------------------|------|
| 3-D Computerscape/source | £189 |
|--------------------------|------|

| | |
|--------------------------|------|
| HALO Professional | £385 |
| INGRAF | £229 |
| MEGAVDI | £579 |
| MetaWINDOW | £190 |
| MetaWINDOW/Plus | £255 |
| MetaWINDOW/Premium | £385 |
| NDP Plot | £200 |
| PC Graphics Library | £385 |
| PC-VDI | £255 |
| PCX Prog Tkt w/source | £389 |
| PCX Programmer's Toolkit | £165 |
| PHONTM-The Fontmaker | £255 |
| ProGraphx Toolbox source | £259 |
| Quick Geometry Library | £129 |
| QuickWINDOW/C | £99 |
| Turbo Halo | £85 |
| TurboWINDOW/C | £99 |
| TurboWINDOW/Pascal | £99 |
| VID and DIG Graphics Lib | £259 |

GRAPHICS WINDOWS

| | |
|------------------------|------|
| Essential Graphics GUI | £195 |
|------------------------|------|

| | |
|---------------------|------|
| Font-Tools w/source | £165 |
|---------------------|------|

| | |
|---------------|------|
| graphics-MENU | £165 |
|---------------|------|

| | |
|-----------------------|------|
| graphics-MENU Pro Pak | £325 |
|-----------------------|------|

| | |
|-----------------|------|
| GSS XVT for DOS | £385 |
|-----------------|------|

| | |
|-------------|------|
| Object-Menu | £239 |
|-------------|------|

| | |
|-------------------------|------|
| Object-Menu with source | £579 |
|-------------------------|------|

| | |
|-----------------------|------|
| T-Windows with source | £190 |
|-----------------------|------|

| | |
|-------------------------|-----|
| TEGL Windows Toolkit II | £65 |
|-------------------------|-----|

| | |
|------------------------|------|
| Zinc Interface Library | £129 |
|------------------------|------|

| | |
|-----------------------|--|
| COMMUNICATIONS & LANS | |
|-----------------------|--|

| | |
|----------------|------|
| dB/LIB Network | £375 |
|----------------|------|

| | |
|---------|------|
| Net Lib | £195 |
|---------|------|

| | |
|---------------------|------|
| Netware C Interface | £190 |
|---------------------|------|

| | |
|---------------------------|------|
| Network System Calls Clip | £190 |
|---------------------------|------|

| | |
|-------------------|-----|
| Network Toolbox/N | £90 |
|-------------------|-----|

| | |
|--------------|--|
| TEXT SCREENS | |
|--------------|--|

| | |
|-------------------------|------|
| C-Worthy Library Source | £175 |
|-------------------------|------|

| | |
|---------------------------|------|
| C-Worthy Upgrade to v.2.0 | £125 |
|---------------------------|------|

| | |
|----------------------|------|
| C-Worthy/cwArchitect | £389 |
|----------------------|------|

| | |
|---------------------------|------|
| 3-D MiniCAD w/source | £450 |
| ChartBuilder | £99 |
| dGE | £195 |
| EGA Toolkit | £159 |
| Essential Graphics Chart | £905 |
| Essential Graphics Kernel | £129 |
| Flipper | £190 |
| FontWINDOW | £99 |
| Geograf Prof. Ed. | £210 |
| GFORCE | £185 |
| GFX Font & Icon Editor | £65 |
| GFX Fonts & Menus | £99 |
| GFX Fonts/Menus/Graphics | £165 |
| GFX Graphics | £99 |
| Grafmatic | £165 |
| GrafPrint | £129 |
| Graph Link | £129 |
| GraphiC | £300 |
| Graphix | £169 |
| GraphPak Professional | £99 |
| GSS Graphics Dev. Tkt. | £515 |
| GSS*CGM Metafile Interp. | £319 |
| GSS*GKS Kernel System | £515 |
| GX Developers Pak | £435 |
| GX Effects | £129 |
| GX Effects w/Source | £259 |
| GX Graphics | £129 |
| GX Graphics w/source | £259 |
| GX Text | £99 |
| GX Text w/Source | £195 |
| Halo F/X | £195 |
| Halo Image File Format | £185 |

SHAREWARE FOR DEVELOPERS

| | |
|---------------------|------|
| ASM Library (20) | £40 |
| C/C++ Library (68) | £66 |
| dBASE/Clipper (87) | £100 |
| DOS Utilities (37) | £40 |
| Novell Netware (54) | £66 |
| Turbo Pascal (38) | £40 |
| Visual BASIC (11) | £40 |
| Windows (64) | £100 |

(Number of diskettes)

| | |
|---------------------------|------|
| 386 DEBUG | £129 |
| 386 DOS-Extender Dev. Kit | £319 |
| 386 VMM | £190 |
| C Network Compiler/386 | £645 |
| C++ Developer's Edition | £399 |
| EDU-16 | £319 |
| F77L-EM/32 w/OS/386 | £899 |
| Fortran 77 386/486 | £645 |
| LinkLoc | £515 |
| Metaware High C 386/486 | £645 |
| MetaWare Pascal 386/486 | £579 |
| NDP C++ | £545 |
| NDP C-386 | £545 |
| NDP C-486 | £750 |
| NDP C-SX | £350 |
| NDP Fortran-386 | £545 |
| NDP Fortran-486 | £750 |
| NDP Fortran-SX | £350 |
| NDP Pascal-386 | £545 |
| OS/286 Developer's Kit | £449 |
| OS/386 Developer's Kit | £449 |
| Smalltalk/V 286 | £129 |
| SVS C/ANSI C | £775 |
| SVS Fortran-77/386 | £965 |
| SVS Pascal/386 | £775 |
| WATCOM C 8.5/386 Prof | £515 |
| WATCOM Fortran 77/386 | £515 |

OTHER C COMPILERS

| | |
|---------------------------|------|
| C-terp | £195 |
| Instant C | £319 |
| Metaware High C DOS x86 | £319 |
| TopSpeed C - Professional | £169 |
| WATCOM C 8.5 Professional | £319 |

DATABASE MANAGEMENT

| | |
|---------------------------|------|
| Alpha Four | £345 |
| Clarion Personal Dev. 2.0 | £79 |
| Clarion Professional Dev. | £679 |
| PALCOM Network | £645 |
| PALCOM Single User | £319 |

xBASE

| | |
|-------------|------|
| Clipper 5.0 | £325 |
| FoxBASE+ | £295 |
| FoxPro | £495 |
| FoxPro/LAN | £695 |
| Quicksilver | £389 |

OBJECT-ORIENTATED

| | |
|---------------------------|------|
| Smalltalk/V | £85 |
| Smalltalk/V 286 | £129 |
| Smalltalk/V Windows | £325 |
| PASCAL | |
| MetaWare Prof. Pascal x86 | £385 |
| Stony Brook Pascal+ | £190 |
| TopSpeed Pascal - Prof. | £109 |
| TopSpeed Pascal - Std. | £109 |

SQL

| | |
|--------------------|------|
| Faircom SQL Server | £319 |
|--------------------|------|

UPGRADE TO MICROSOFT C/C++7.0

| | |
|----------------------------|------|
| Microsoft C (any) | £149 |
| Borland/Turbo C++ (any)*</ | |

the palette in 0.05 seconds, when the others take between 8.5 and 17 seconds to perform **exactly** the same task? Unlike the other libraries which use `int 10h` (the ROM BIOS video driver) to talk to the graphics card, Flash graphics writes directly to the hardware. This is possible because Flash Graphics provides specific hardware-dependent graphics routines for each of the graphics cards that it supports.

Only BGI and Flash Graphics provide calls which let you specify both end-points when drawing a line. I achieved the same result with the other libraries by using a combination of `movtos` and `linetos`. This additional overhead is reflected in the results for 'Draw Line'.

There are usually several ways to draw a complete circle if there isn't a library call that already does it for you (eg Borland's `circle` function). A circle is a special case of an ellipse in which the radius along the X-axis is equal to the radius along the Y-axis. I used this definition to produce the Microsoft, Topspeed, Watcom and Zortech circle drawing tests (ie with these libraries, the `ellipse` library call was used to output a circle).

Looking at the results for 'Draw sector' we can see that the Microsoft library is the clear winner in this test. What's interesting here is the fact that the two endpoints of the sector had to be calculated using floating point arithmetic before being cast to integer values. Although BGI allows the programmer to specify these parameters as integer Start and End angles, the overall result is somewhat slower than Microsoft.

Conclusion

All the graphics libraries that I have tested were adequate for their purpose. However, there were significant differences between the offerings, which merit being taken into account when selecting a C compiler for DOS graphics development.

JPI's TopSpeed library probably offered the least, even though it attempted compatibility with the two graphics standards. In particular, its MS implementation was incomplete and slow. Solid old Watcom's graphics library is, well, a bit too solid - one would expect a bit more speed from the famous Canadian optimiser. Watcom carries off the consolation prize of 'best do-

cumentation', though. Symantech/Zortech's effort was perhaps the most bizarre. Points gained for the wide range of graphics adapters supported and the speedy low-level calls were rapidly lost by a clumsy API and some high-level primitives that were either missing or sloppily implemented.

This leaves Microsoft and Borland. According to my tests, the MS library emerged as the speediest of the bunch. Its API was very complete. We particularly admired the ability to use Windows fonts, and the facility to map world coordinates to screen coordinates. Nonetheless, Microsoft offered no help in supporting non-standard adapters. So, for its reasonable performance, its intuitive API, its loadable device drivers and its excellent documentation, I vote in Borland's BGI as the best all-rounder in the bunch.

EXE

The following prices were supplied by The Software Construction Company and include p&p but not VAT. Borland C++ V3.0 - £189. Microsoft C V6.0 - £215. Topspeed C V3.0 (standard) - £109. Watcom C V8.5 - £319. Zortech C++ V3.0 (standard) - £249.



Facts-Direct .EXE Reader Service

Facts-Direct is an on demand information enquiry service.

For registered advertisers, product information is available for you to retrieve at your convenience using your fax machine and telephone.

Advertisers can ...

- ▶ Maximise effectiveness of advertising with a fulfilment mechanism that can satisfy a reader's interest within minutes of reading an advertisement.
- ▶ Satisfy enquiries 24 hours a day seven days a week regardless of office opening hours, geographic location or the postal service.

As a reader you can ...

- ▶ Retrieve information at your convenience any hour of the day.
- ▶ Obtain information within minutes of seeing an advertisement.
- ▶ Eliminate the tedious wait for a postal response to an enquiry.

Try it now ...

Use your faxphone (it should be capable of generating touch tones) and call Facts-Direct on 0865 727232. Follow the simple instructions given by the voice system to retrieve 300300.



Facts-Direct Ltd, Suite 2, Kennet House, 108-110 London Road, Oxford, OX3 9AW

Tel: 086 736 696

CIRCLE NO. 569

Delivering the Power: WATCOM C9.0/386

- **The Widest Range of 32-bit Intel x86 Platform**
32-bit DOS, 32-bit Windows, OS/2 2.0, AutoCAD, ADS
- **The Industry's Leading Code Optimizer**
Advanced global optimizer with new 386-specific optimizer
- **The Most Comprehensive Toolkit**
Debugger, profiler, protected mode compiler and linker, 32-bit DOS extender with royalty-free run-time license, components from Microsoft SDK, and more
- **The Best Value in 32-Bit Tools: \$895***

Unleash 32-bit Power!

WATCOM C9.0/386 lets you exploit the two key 32-bit performance benefits. The 32-bit flat memory model simplifies memory management and lets applications address beyond the 640K limit. Powerful 32-bit instruction processing delivers a significant speed advantage: typically at least a 2x speedup.

You Get:

- 100% ANSI and SAA compatible: C9.0/386 passes all Plum Hall Validation Suite tests
- Extensive Microsoft compatibility simplifies porting of 16-bit code
- Royalty-free run-time for 32-bit DOS, Windows and OS/2 apps
- Comprehensive toolkit includes debugger, linker, profiler and more
- DOS extender support for Rational, Phar Lap and Ergo
- Run-time compatible with WATCOM FORTRAN 77/386

32-bit DOS support includes the DOS/4GW 32-bit DOS extender by Rational Systems with royalty-free runtime license

- Virtual Memory support up to 32Mb

32-bit Windows support enables development and debugging of true 32-bit GUI applications and DLLs.

- Includes licensed Microsoft SDK components

32-bit OS/2 2.0 support includes development for multiple target environments including OS/2 2.0, 32-bit DOS and 32-bit Windows

- Access to full OS/2 2.0 API including Presentation Manager
- Integrated with IBM Workframe/2 Environment

AutoCAD ADS and **ADI** Development: Everything you need to develop and debug ADS and ADI applications for AutoCAD Release 11

Novell's Network C for NLM's SDK includes C/386

The Industry's Choice.

Autodesk, *Robert Wenig, Manager, AutoCAD for Windows:*

"At Autodesk, we're using WATCOM C/386 in the development of strategic new products since it gives us a competitive edge through early access to new technologies. We also highly recommend WATCOM C/386 to third party AutoCAD add-on (ADS and ADI) developers."

Fox Software, *David Fulton, President:* "FoxPro 2.0 itself is written in WATCOM C, and takes advantage of its many superior features. Optimizing for either speed or compactness is not uncommon, but to accomplish both was quite remarkable."

GO, *Robert Carr, Vice President of Software:* "After looking at the 32-bit Intel 80x86 tools available in the industry, WATCOM C was the best choice. Key factors in our decision were performance, functionality, reliability and technical support."

IBM, *John Soyring, Director of OS/2 Software Developer Programs:* "IBM and WATCOM are working together closely to integrate these compilers with the OS/2 2.0 Programmer's Workbench."

Lotus, *David Reed, Chief Scientist and Vice President, Pen-Based Applications:* "In new product development we're working with WATCOM C because of superior code optimization, responsive support, and timely delivery of technologies important to us like p-code and support for GO Corp's. PenPoint."

Novell, *Nancy Woodward, V.P. and G.M., Development Products:* "We searched the industry for the best 386 C compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."

WATCOM

1-800-265-4555

The Leader in 32-bit Development Tools

415 Philip Street, Waterloo, Ontario, Canada Telephone: (519) 886-3700, Fax: (519) 747-4971 * Price does not include freight and taxes where applicable. Authorized dealers may sell for less. WATCOM and Lightning Device are trademarks of WATCOM Systems Inc. DOS/4G and DOS/16M are trademarks of Rational Systems Inc. Other trademarks are the properties of their respective owners. Copyright 1992 WATCOM Products Inc



CIRCLE NO. 570



Complete Control

Paul Kemp has been jazzing up his Windows apps with some cool new controls from Blaise's Windows Control Palette.

Bored with Windows' standard controls? The Windows Control Palette (WCP) from Blaise Computing takes advantage of Windows DLLs to give programmers an extended collection of posh-looking custom controls. Because their default behaviour is predefined they are simple to use and require little programming effort.

Basics

At the heart of WCP is a DLL (CPALLETTE.DLL) which, when loaded, registers the WCP controls so that they can be used like any other Windows control. This DLL can be called from any language that supports DLL access. Header files, example programs and static link libraries are supplied for Microsoft C (or compatible), Borland C++ (versions 2.0 and 3.0), Turbo C++ for Windows and Turbo Pascal for Windows (TPW) - full Visual Basic support will be available in March and will be supplied as a free upgrade to existing users of WCP. Support DLLs are also provided so that the WCP custom controls can be 'seen' by re-

source editors: Borland's Resource Workshop and Microsoft's Dialog Editor (with VB support in the upgrade). I particularly liked this feature, especially with Resource Workshop where the new controls rather neatly tack themselves onto the toolbar along side Borland's own custom controls and the standard Microsoft ones.

Controls in detail

The nine WCP controls are listed in Figure 2 and a selection are shown in Figure 1. The CPDialog class implements special 'fast painting' of WCP controls and also displays a textured background similar to Borland's 'chiselled steel' effect. CPButton, CPRadioButton and CPCheckBox controls are fully configurable so that the programmer can supply an appropriate set of bitmaps which represent the control in each of its possible states. There are attractive defaults provided and a great many more bitmaps available in another DLL (CPBITMAP.DLL) if you don't want to create your own. Once you have primed the

control with the necessary bitmap handles, they are automatically switched at run-time in response to user interaction.

CPStatic controls are used to display static text, icons and bitmaps in dialogs or client window areas. Extra style settings are available for text display which give a raised or lowered appearance to the characters. In a similar style to Borland's BorShade control, WCP's CPCanvas class can be used to display a raised or lowered, shaded rectangle upon which other controls can be painted. Horizontal and vertical lines can also be drawn. This control would normally be used to group controls on a dialog or to separate portions of a window.

The most innovative of the new controls are CPMeter, CPSpin and CPToolBar. Unlike the other WCP controls which are enhanced versions of standard controls, they constitute a small set of entirely new interface elements. A CPMeter is one of those thermometer-style things that Windows install programs are so fond of (and so often abuse - have you noticed how they get to 100% and then rather cheekily go back to 0% and start all over again?). The application sets the range and progress of the creeping ooze, while the control calculates and displays a 'percentage complete'. The dimensions and colour combinations of the bar are also configurable.

CPSpins are spin button controls that consist of a pair of bitmapped buttons indicating *increase* and *decrease* (or *up* and *down* if you fancy). As with the other button-type controls, the application can supply bitmaps for these buttons (two for each of the pair, four in all) or leave the control to use its own defaults. Notification messages are sent to the control's parent window when the user clicks on either of the buttons.

My favourite of the bunch is the CPToolBar. A toolbar in WCP-speak is one of those free-floating chocolate bars as seen in Visual Basic and now common in many other Windows apps. After creating a tool-

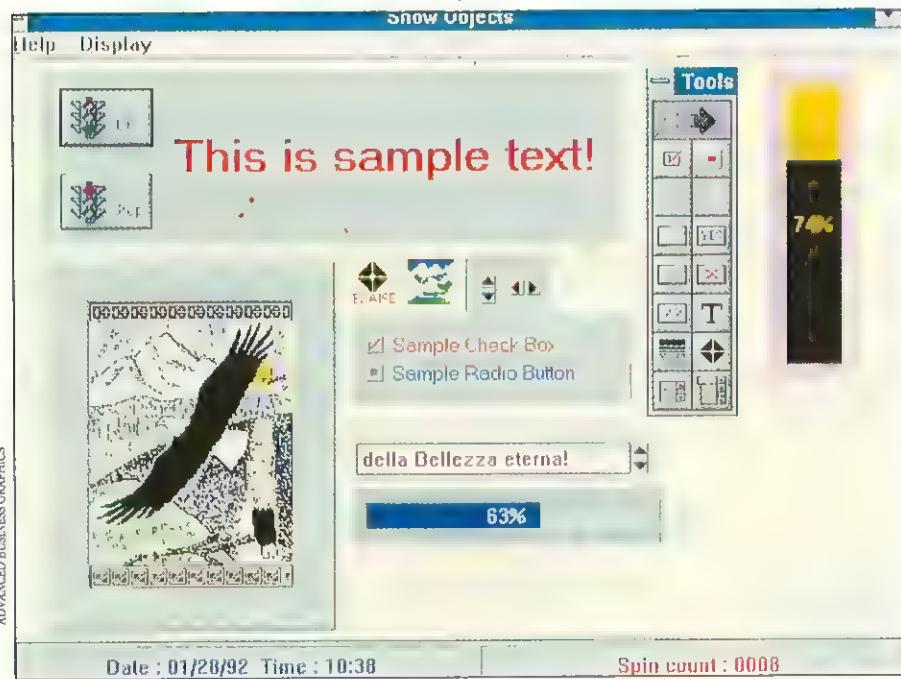
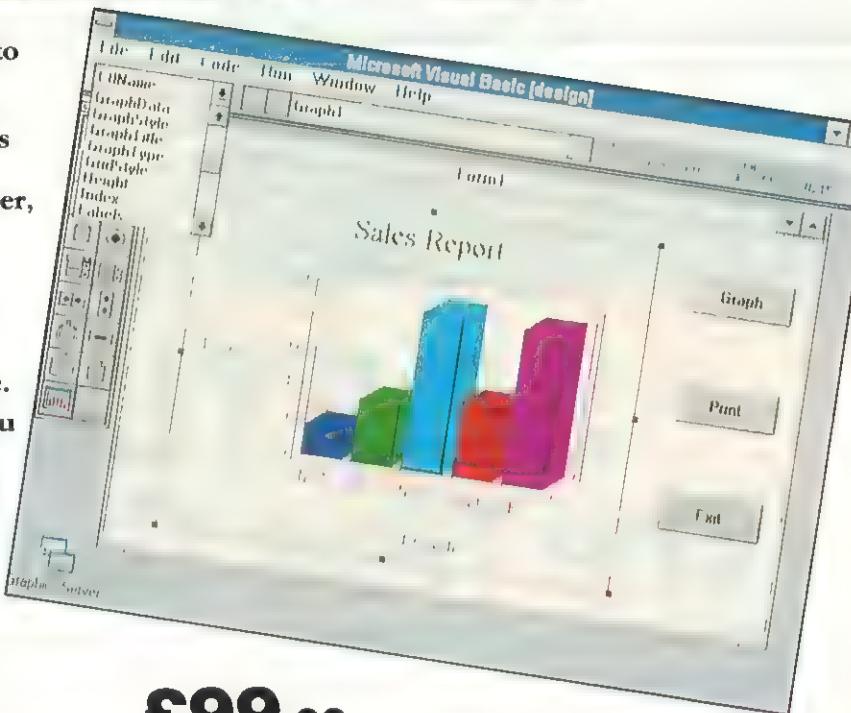


Figure 1 - WCP examples

CHARTBUILDER

FOR VISUAL BASIC

- Integrate graphs and charts directly into your Visual Basic applications.
- Manipulate your graph objects using standard Visual Basic properties, events and methods.
- Present your data as pie, bar, line, scatter, area, gantt, polar and high-low-close graphs.
- Add statistical lines and trends.
- Create high-quality hardcopy.
- Interchange images with other applications via Clipboard and Metafile.
- Pay no royalties on the applications you create.
- ChartBuilder comes complete with a royalty free run-time copy of Bits Per Second's Graphic Server, the unique charting library for Windows developers.



Bits Per Second Ltd

14 Regent Hill, Brighton BN1 3ED
Tel: (0273) 727119 Fax: (0273) 731925

£99.00 + VAT

CIRCLE NO. 571

Spot the difference...



All of these screens have been taken from Clipper applications. The difference is that four of the screens use the GFORCE graphical user interface.

GFORCE provides a very fast Windows-like environment as a linkable library for the Clipper compiler.

GFORCE includes low level functions for pixels, lines, boxes

circles, fills, bitblits and high level functions for 3D buttons, pull down menus, dialogs, scroll bars, icons, bitmaps and fonts.

GFORCE retails for £185.00 including full documentation, Norton Guides, Quick library with complete Clipper source, graphical font and icon editors with Clipper source and ninety days technical support.

GFORCE works with Clipper 5.01, Summer '87 and overlay linkers such as Blinker etc.

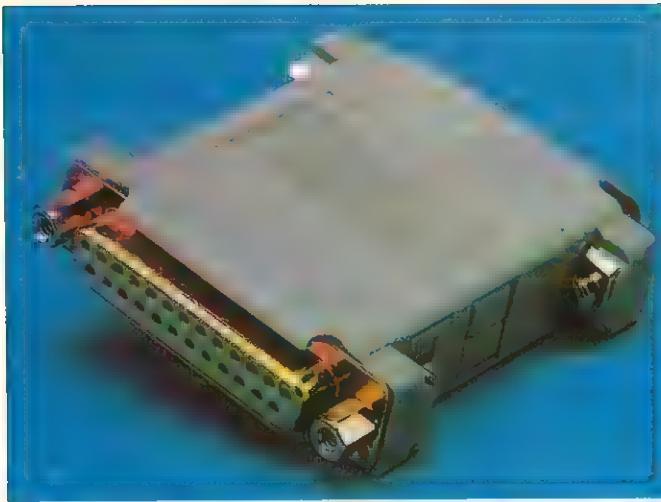
Please call for a free demo disk.

QBS Software Ltd
10 Barley Mow Passage
London W4 4PH, ENGLAND
Tel: 081 994 4842
Fax: 081 994 3441

CIRCLE NO. 572

GFORCE™

Clipper Graphical User Interface



How many users of your software paid for it???

SOFTLoK International Limited was established in 1987 with the introduction of our SOFTLoK and SOFTLoK PLUS devices to combat the ever increasing problem of software piracy. Our SOFTLoK range of software protection devices are used by hundreds of software developers from small consultancies to large multinationals. To cope with the ever changing needs of our customers we have developed SOFTLoK II which combines the programmable features of SOFTLoK PLUS with a low unit cost similar to our original SOFTLoK product.

SOFTLoK II™

The Next Generation

SOFTLoK II units are programmable devices containing read/write memory protected by a password. Both the memory and the password can be changed at any time using our routines in your application software. Easy to use menu-driven software is provided to allow small or large batches of SOFTLoK II units to be programmed with their initial data & passwords ready to be sent out with the protected software product.

Price: 1-19 £16.90, 20-49 £15.40,
50+ £13.70

Evaluation kit £20 (SOFTLoK II, manual & software)
All prices excl. VAT and delivery



As SOFTLoK II units plug into the parallel printer port they can be installed or removed in seconds.

- For IBM PC, PS/2 and compatibles
- Uses parallel printer port
- Totally transparent to printer
- Secure data & password can be changed from your application software
- Cascadeable
- 240 bytes of secure read/write memory
- 8 byte (64 bit) password
- No programming adaptors required
- Easy to use SOFTLoK II setup software
- Routines ready to link with various compilers
- Easy to follow manual

I-MEX House, 40 Princess Street,
Manchester, M1 6DE, England,
Tel: 061 228 7379 **Fax:** 061 236 6890

| WCP control name | OWL classes (C++ & TPW) |
|------------------|---|
| CPDialog | TCPDialog |
| CPButton | TCPButton |
| CPRadioButton | TCPRadioButton |
| CPCheckBox | TCPCheckBox |
| CPStatic | TCPStatic, TCPStaticBitmap, TCPStaticIcon, TCPStatusField |
| CPCanvas | TCPCanvas, TCPGroupBox, TCPSpinList, TCPStatusLine |
| CPMeter | TCPMeter |
| CPSpin | TCPSpin |
| CPToolBar | TCPToolBar |

Figure 2 - WCP controls

bar object in the application, the programmer initialises a two dimensional array of bitmap handles which represent the component buttons in their 'up' and 'down' states. From here on in the bitmaps are automatically alternated in response to the user's mouse clicks, and messages are sent to the toolbar's parent indicating which button has been selected.

Programmer's perspective

In addition to supporting Blaise's own Windows C++ application framework Win++, WCP comes with a complete interface for use with Borland's ObjectWindows library (OWL). Figure 2 shows the relationship between WCP controls and OWL classes. The WCP classes for both TPW and BC++ are

derived from OWL base classes. Two of these classes in particular extend the functionality of the basic WCP controls by encapsulating more complex behaviour.

The TCPSpinList class is a combination of three interface objects: a spin button, a static text control and a background canvas. It's a bit like a drop-down combo box without the drop-down. The object provides two built-in ways to control the values displayed in the text field. Using one way, you provide an array of character strings to display as the internal index (or *spin counter*) changes in value. In the other way, the actual numeric value of the spin counter is shown.

A TCPStatusLine is a special type of TCPCanvas which is associated with one

or more StatusField objects (which are derived from TCPStatic). Status lines can be placed anywhere within the client area and have a member function to move them and the status fields in concert when the client area changes in size.

Conclusion

I liked the Windows Control Palette although I would have been happier with more detailed documentation and better example programs. It is a good example of a third party library stepping in to plug the gaps left in more mainstream development systems, even though there is some overlap with Borland's custom controls. I was particularly impressed by its comprehensive support for different languages and tools, and the ease with which the controls could be used. This is what code reuse is all about, let's hope we see more high quality add-ons like this in the future.

EXE

The copy of Windows Control Palette from Blaise Computing Inc was supplied for review by Grey Matter (0364 53499) who quoted a UK price of £99 excl VAT.

EIFFEL: NOW AVAILABLE FOR MS-DOS

We are pleased to announce the release of Eiffel/S, the Eiffel compiler for MS-DOS.

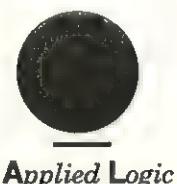
Eiffel enables you to produce efficient, well-documented, reusable software, taking full advantage of the benefits offered by object-oriented technology.

Eiffel/S, written in version 3 of the Eiffel language, is fully approved by the International Eiffel Consortium. Features include:

- Extensive libraries: basic classes, I/O classes, persistence classes, data structure classes
- Production of optimized C code
- Fast syntactical analyzer
- Platform independence
- Eiffel/S is available for MS-DOS, OS/2, UNIX.

For further information contact:

Applied Logic Developments
9 Princeton Court
55 Felsham Road
London SW15 1AZ
Tel: 081 780 1088
Fax: 081 780 1941

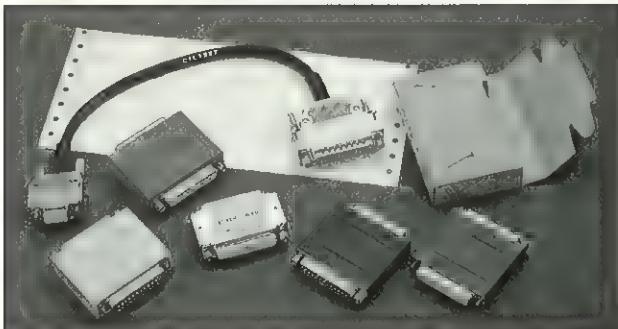


SOFTWARE SECURITY MODULES

Hardware devices (dongles) are a recognised and proven means of protecting software from unauthorised use and piracy.

Our range of devices offers some of the most robust and troublefree solutions around. All units are cascadeable and can be uniquely coded for each customer. Features include:

- PC/non-PC.
- RS232/Printer.
- Internal memory (some units)
- Software drivers supplied.
- Minimum 2 year guarantee.
- From £14 to £50



Control Telemetry of London
11 Canfield Place, London NW 3BT
Tel: 071 328 1155 Fax: 071 328 9149

Get your act together!

Jules has been speaking to computer salesmen, this month. He's a bit distraught.

I have been a fan of the *idea* of portable computers for years - indeed I had one of the first palmtops about ten years ago (before there was such a word). Until recently, though, I was not so sure about the reality - most desktop machines are far more practical for most people than even the most fashionable portable. However, I think laptops are reaching the stage now where they are becoming genuinely useful, with sensible battery lives and reasonable compute power, so when a job came up that needed a laptop, I accepted it and went shopping. Most laptops and portables are (like most computers everywhere) DOS-compatible. I can't see the point of this - trying to type program names or (worse!) Wordstar keystrokes onto a tiny keyboard in a bucking car is not my idea of fun. No, DOS has its places, but planes, trains, and automobiles are not among them.

The problem was, having ruled out a DOS box, I was in uncharted territory! I found myself in the realms of operating systems, peripherals, and application programs that neither I, nor any of my colleagues, knew anything about. That is, I found myself in the same position that the vast majority of prospective computer users do every time they put their hand in their pocket! What does one do in such a situation? What I did was to buy several of the magazines which contain more advertising than editorial (you know the ones you take home in a wheelbarrow?), and looked through them. I found the respectable-looking suppliers, and I found the respectable-looking machines. I read a few reviews, and I eventually decided on a Holger 245 (not its real name, by the way!) complete with an accessory pack which made it actually useful. I contacted a firm who had a large colour photograph of the Holger in its advertising, and was quoting a pretty good price, and I rang up to place my order. 'Oh no', they said, 'We're not selling that any more. You see, there's a new version coming out next month, and we're going to sell those instead. Can I take your order for that?' Did they have any brochures for it? Did they know how much it was going to cost? Did they know when

they were due to get some? Did they know who was going to make it? Nope! They knew nothing whatever, yet they still were prepared to take my order.

I was given no less than five different (and untrue) reasons why the machine had been deleted

I called the number of the manufacturer which they gave me, and found it had been disconnected. I eventually tracked the company down (they had moved - to a different country), and asked them what the story was. Yes, there was a new version, due out in about eighteen months. They were not planning to discontinue the old one. Could they sell me one? Yes, at twice the price the supplier had been advertising, and no, they wouldn't bargain. I called the supplier back, and they told me I had been misinformed. They *had* deleted the computer from their list, but for a wholly different reason to the one given earlier. To cut a long story short, over five separate phone calls I was given no less than five different (and incompatible, and untrue) reasons why the machine had been deleted. Good work, guys!

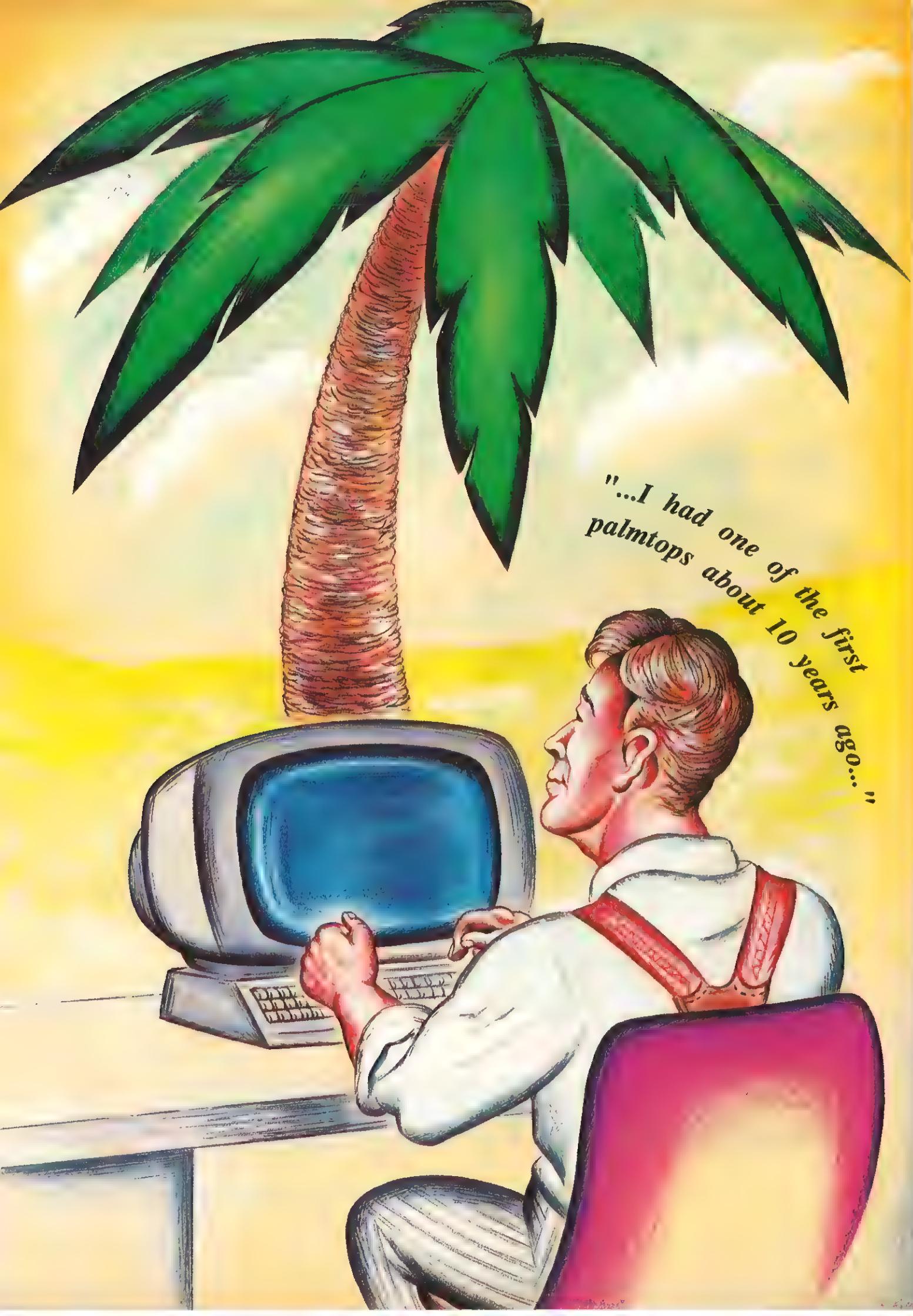
Over the next few days, I called a number of suppliers, and found a variation in price for identical equipment of 300%. The bag of accessories had been discontinued, and only one company (from perhaps 30) could tell me what configuration I actually needed. The Americans gratuitously wished me nice days, the British were characteristically sullen, and even the Asians wouldn't haggle. Eventually, I did some-

thing I swore I would never do, and bought second-hand. I got the equipment I wanted, I got enough help from the seller to get it going, I got some useful hints, and I got the price I wanted. I have disguised the names of the companies involved, not to protect their (or my) interests (you know who you are!), but because my experience is not unusual. I tried a similar exercise with other machines and with other companies and found the same thing.

Of course, people joke about computer salesmen the way they joke about estate agents, but I have been so close to DOS boxes that I hadn't noticed - I always knew what I wanted, and didn't need to have it explained to me. What occurs to me, though, is that for a small-volume item with (apparently) hefty mark-up, the situation is pretty bad, but for DOS boxes, which are high-volume and very low mark-up indeed these days, the situation must be even worse. I thought only incurable technophobes said 'computers are too complicated', but I now see that, for the average user, such an experience would be so daunting he may well walk away from the problem. Is it my job (as a programmer) to sell the idea of a computer to a customer, or a secretary's job to sell the idea to her boss? What do these salesmen think they are being paid for? We hear a lot of complaint these days that the computer market is not what it was, and that we should feel sorry for the box-shifters because they can no longer charge 30% or 40% mark-up in a market which is reaching saturation. Cobblers! If the market is changing, then selling styles must change, and if that means telling customers what they need to hear in order to feel good about a purchase, so be it. Salesmen in every other industry know this, why not in ours? Come on, salesmen - get your act together!

EXE

Jules May is a keen user of both desk-bound PCs and at least one laptop. He doesn't sell computers, but is considering the possibility. He can be contacted on 0707 44185 or on cix as jules.



*"...I had one of the first
palmtops about 10 years ago..."*

Unleash The True Power Of C++



It Takes More Than The Language.

Unleashing the full potential of C++ takes powerful object-oriented tools and a rich library of classes. Using only a C++ compiler and traditional tools yields traditional results — slipped schedules and maintenance nightmares. Only Objectworks\ C++, Release 2.4, provides the comprehensive development environment that allows you to produce extraordinary results.

Speed Your Development and Maintenance.

Objectworks\ C++ provides dynamic, graphical browsers to illuminate the tangle of class relationships, object interactions, and program structure, as no static or textual information possibly can. The unique integration of the C++ source level debugger and interactive browsers ensure that essential information is instantly at your finger tips. And, a broad range of cross references are as close as a point and click. All of these tools aid in the understanding of code, increase reuse, decrease confusion, promote consistency and, ultimately, speed your development and maintenance.

An Open Environment.

Based in the latest AT&T C++ language System, Release 2.1, Objectworks\ C++ provides support for SunView and X Windows on Sun platforms. Its open environment also allows you to use your favourite C preprocessor, C compiler, linker, profiler, or source code control system. The sophisticated class libraries included in Objectkit\ C++ exploit the natural synergy between the development environment and the extensive reusable class libraries. Objectworks\ C++ also allows programmers to use existing makefiles without any modification, saving time and money.

Team Programming.

Objectworks\ C++ is the only C++ development environment that allows engineers to work cooperatively, loading and browsing one another's code, without interrupting each other. Programmers simply access an information file containing a description of the code they need, and then they query this description.

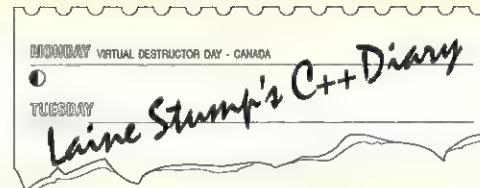
AI International are uniquely qualified to help you exploit the benefits of object-oriented technology and C++ programming applicable to your development efforts. If you'd like our technical management brief "Exploiting the Full Benefits of C++ Objects", or are ready to unleash the true power of C++, call us today at 0442 876448

**Without Objectworks, you're
without objects.**



AI INTERNATIONAL LIMITED

The Chapel, Park View House, 1 Park View Road, Berkhamsted, Herts, HP4 3EY
Telephone: 0442 876448 Fax: 0442 877997



Writing reusable classes

Five Top Tips on C++ class design from Laine Stump, our man in Ankara.

After becoming completely swallowed by a new methodology, you sometimes make the mistake of thinking the rest of the world is in just as deep as you. Since I have spent the last three years madly buying books about C++ and experimenting with OOP, I of course assumed that all other programmers had similarly thrown out Kernighan and Ritchie in favour of Stroustrup, and Wirth in favour of Meyer. I was even worried that, in my absence from the 'software scene' in the US, I was falling behind the times. Somehow I had a vision that all the software houses were making a mass shift to Object Orientation, which would eventually render me obsolete.

But during a visit to Seattle this summer, we had dinner with a hardware engineer friend of mine. Eventually the discussion got around to C++ and OOP, and I was a bit shocked when he told me that, in August of 1991, his company was still using standard C for all their development. They were interested in OOP, he said, but were so pushed by management to produce results that none of the software people had been able to investigate. They hadn't even upgraded their Turbo C V2.0 compiler!

This situation seems to be quite widespread. Everyone knows 'OOP is good', but the corporate bean counters don't give the engineers enough time to learn how to take advantage of it. Many who have traded up to a C++ compiler are just using it as a glorified C compiler. It's really sad to see so many megabytes of disk space going to waste (a full installation of the latest Borland C++ takes over 40 MB!).

Thinking back through my own early experiences with OOP and C++ (which are still continuing!), I have come up with a few

```
class Light (...);
class RedLight : public Light (...);
class YellowLight : public Light (...);
class GreenLight : public Light (...);
class TrafficLight : public RedLight,
    public YellowLight, public GreenLight (...);
```

Figure 1 - Excessive inheritance

pointers to help those with limited time to avoid the rocks and whirlpools when they dive into the object-oriented river. The discussion of class design and reuseability that follows is not based on academic research, it is simply what I have found to work, and is open to criticism (please leave the rotten vegetables at home, though).

Unless you have a good reason, prefer Wide classes over Deep classes

Reuse

Any good book will tell you that three of the most important features of OOP languages are Encapsulation, Inheritance, and Polymorphism. All three lead to one of the 'promises of OOP': Reuse. Most of us immediately embrace the first two features (which we have been secretly using in conventional languages anyway), but are a bit confused about the third. Unfortunately, inheritance and encapsulation are both severely crippled without proper doses of polymorphism (on the other hand, polymorphism is impossible without inheritance).

Polymorphism is realised in C++ via virtual functions. Basically, each instance of a class contains a table of pointers to the functions which have been designated as `virtual` for that class. At run time, rather than calling a function directly, it is called indirectly through the virtual function table (sometimes called virtual method table, or 'VMT'). The result is that the routine actually executed depends on the type of object for which it was called.

The Inheritance Tree

For some reason, many neophyte OOP programmers are so struck by the concept of inheritance that they want to inherit everything. This leads to class structures like that of Figure 1, an admitted extreme example. The obvious problem here is that we have tried to embed an attribute of an object (its colour) into the class definition. This not only limits the usefulness of the class, but makes it difficult to derive any new classes.

My 'First Hint to Reuseability': Don't embed simple attributes into the 'soul' of the class or make it more specific than necessary.

Wide vs Deep

Another symptom of the Inheritance Craze is what I call Deep classes. The `ColourGrDev` class in Figure 2 is an example of a Deep class. Aside from making it difficult to figure out what functions are available (you have to search back through the entire inheritance tree), this deepness causes problems within the class itself. For example, if

```
// Deep version
struct Dev
{
public:
    void open();
    void close();
};

struct GrDev : public Dev
{
    int cx, cy;
    void moveto(int x, int y);
    void lineto(int x, int y);
    void circle(int x, int y, int r);
};

struct ColourGrDev : public GrDev
{
    int colour;
    void setcolour(int c);
};

// Wide version
struct ColourGrDev
{
    int cx, cy, colour;
    void open();
    void close();
    void moveto(int x, int y);
    void lineto(int x, int y);
    void circle(int x, int y, int r);
    void setcolour(int c);
};
```

Figure 2 - Deep vs Wide classes



```

class GradeList
{
    int *data;
    int count;
public:
    GradeList(int ct)
    {
        count = ct;
        data = new int[count];
    }
    ~GradeList() { delete data; }
    int Count() { return count; }
    int Get(int i) { return data[i]; }
    void Put(int i, int g) { data[i] = g; }
    int Average()
    {
        int sum = 0;
        for (int ct = 0; ct < count; ct++)
            sum += data[ct];
        return sum/count;
    }
};

```

Figure 3 - GradeList #1 - poor encapsulation

you want `circle()` to be able to draw a coloured circle it must have access to the current colour, but `circle()` is defined in `GrDev`, while the colour is not available until `ColourGrDev`. You could redefine the members of `GrDev` in `ColourGrDev`, but that would render `GrDev` itself nearly worthless, as all its members except `moveTo()` need colour, so they would all be redefined.

Unless the intermediate classes serve some other purpose (for example, maybe other types of devices will have `open()` and `close()`, but no line drawing), I prefer to use Wide classes. The second definition of `ColourGrDev` in Figure 2 is Wide. The advantages of Wide classes are that they are easier for client programmers to understand, and they eliminate the member visibility confusion we saw above.

The 'Second Hint to Reuseability'? I may catch some shrapnel on this one, but: Unless you have a good reason, prefer Wide classes over Deep classes. If you have more than two levels of inheritance before you get to a class that is instantiated (an object is declared), you should be concerned.

```

class GradeList
{
    int *data;
    int count;
public:
    GradeList(int ct)
    {
        count = ct;
        data = new int[count];
    }
    virtual ~GradeList() { delete data; }
    virtual int Count() { return count; }
    virtual int Get(int i) { return data[i]; }
    virtual void Put(int i, int g) { data[i] = g; }
    int Average()
    {
        int sum = 0;
        for (int ct = 0; ct < Count(); ct++)
            sum += Get(ct);
        return sum/Count();
    }
};

```

Figure 4 - GradeList #2 - better encapsulation

Polymorphism

A related mistake is limiting the 'virtual functionality' of a base class. Imagine a `Window` class which is used to derive a `ScrollingWindow` class. Usually the windows of a program are kept in some kind of a list, which in this case would be a list of pointers to `Window` (a `Window*` can point to a `ScrollingWindow`, but the inverse is illegal). We access member functions of these windows through the `Window*`, but since a `Window*` only allows us to call the members which were defined in `Window`, we can't call the functions associated with scrolling.

One solution in this case is to declare empty virtual functions for scrolling in `Window`, and redefine them in `ScrollingWindow`. Now you can call the scrolling functions with a `Window*`, and through the magic of virtual functions, if the window is a `Window` nothing will happen, while if it is a `ScrollingWindow` the appropriate action will be taken.

And so we arrive at the 'Third Hint to Reuseability': Declare as much functionality as possible in the base class using virtual functions; redefine those functions in descendant classes. If this functionality seems out of place in the base class, maybe you need to rename your base class.

Encapsulation

Traditionally, encapsulation has been closely linked to data hiding. The idea is to capture all data structure-dependent code within the functions of the class, resulting in an independence of the class and its client programs. For example, it makes no difference to clients of the `GradeList` class in Figure 3 whether its data is stored as an array, or as a linked list; all client accesses to the data are through `GradeList`'s member functions. This has the dual advantage of removing complexity from the client program as well as allowing different implementations of `GradeList` to be tried without changing the client program.

Remember, though, that users of a class won't just create instances of that class; they may also derive new classes from the original class. If you decide to create a `GradeListFile` which keeps the grades in a file on disk you won't want to rewrite everything. Instead you would like to inherit all the features of the original `GradeList`, changing only features (functions and data) which must be different from the original. That is, after all, the promise of Reuse.

But, although the algorithm for the `Average()` function will be the same for both classes, if you inherit from the `GradeList` of Figure 3, you'll have to rewrite `Average()`, as it accesses `GradeList`'s data members directly, while data in the new class will be stored on disk. The problem is that because the member functions of `GradeList` are tightly coupled to the data, they cannot be reused in a derived class where the data is different.

With a bit of rework to separate the data of the class from its functionality, encapsulating direct data references within *a portion of the class*, you can arrive at the base `GradeList` class in Figure 4, which defines `Average()` in terms of other functions of `GradeList`. Now when you derive `GradeListFile` you will still define `Get()`, `Put()` and `Count()`, but you won't need to redefine `Average()`, as it is defined completely in terms of `Get()` and `Count()`. By defining `Get()` and `Count()` as *virtual* in the base class, you assure that `Average()` will call the proper version for the current `GradeList` (or a descendant) object.

This leads us to the 'Fourth Hint to Reuseability': Encapsulate direct dependencies on the data structure of a class in as few, simple

```

class GradeList
{
public:
    virtual ~GradeList() { }
    virtual int Count() = 0;
    virtual int Get(int i) = 0;
    virtual void Put(int i, int g) = 0;
    int Average()
    {
        int sum = 0;
        for (int ct = 0; ct < Count(); ct++)
            sum += Get(ct);
        return sum/Count();
    }
};

class GradeListArray : public GradeList
{
    int *data;
    int count;
public:
    GradeListArray(int ct)
    {
        count = ct;
        data = new int[count];
    }
    virtual ~GradeListArray()
    {
        delete data;
    }
    virtual int Count()
    {
        return count;
    }
    virtual int Get(int i)
    {
        return data[i];
    }
    virtual void Put(int i, int g)
    {
        data[i] = g;
    }
    // inherits original Average()
};

class GradeListFile : public GradeList
{
    FILE *data;
public:
    GradeListFile(char *name, int ct)
    {
        // open file
    }
    virtual ~GradeListFile()
    {
        // close file
    }
    virtual int Count()
    {
        // read count from file
    }
    virtual int Get(int i)
    {
        // read element from file
    }
    virtual void Put(int i, int g)
    {
        // write element to file
    }
    // inherits original Average()
};

```

Figure 5 - GradeList #3 - abstract base class



functions as possible, defining other functions in terms of those dependent functions; declare the dependent functions as **virtual**. Derived classes will only need to redefine the virtual functions.

Sometimes the 'data' of a class is really represented by a member function. Take, for example, a **Piece** class with descendants **cRectangle** and **cEllipse** (see *Segments From Hell .EXE* Feb '92). A rectangle and an ellipse can be defined with the same data (the coordinates of the enclosing rectangle), but they each use that data in a slightly different way - calling the appropriate function from the graphics library. In this case, a **virtual Paint ()** function should be defined in the base class, and all other functions (**MoveAbs ()**, **MoveRel ()** etc) should be defined in terms of the **Paint ()** function.

Abstract Classes

There is still a problem with version two of **GradeListFile** - although it inherits the data and count members from its base class, it never uses them. This doesn't create any extra work for the programmer, but the two data members are wasting memory. Solving this problem requires an **ab-**

stract base class. An abstract class is one which is never intended to have an instance, it should only be inherited from. In C++, any class which has a pure virtual function (a virtual function which is declared, but not defined) is considered to be abstract.

To arrive at the abstract base class in Figure 5, we simply make a base class which is the same as the base class of Figure 4, except that the virtual functions are declared as:

```
virtual xxx(...)=0;
```

rather than giving a definition for the function ('= 0' means 'pure'). After removing the bodies of all virtual functions, we remove any data members which are not referenced in the non-virtual functions. This yields a base class which can be used to derive both a **GradeListArray** class and a **GradeListFile** class. Notice that we have still succeeded in writing **Average ()** only once.

Finally, the 'Fifth Hint to Reuseability': if you think that you may derive other classes from a class, create an abstract base class by making all virtual functions pure, and removing data members which are not referenced directly by the non-virtual functions.

Further Investigation

Although I have used C++ in my examples, everything I have discussed is valid for any object-oriented language. If you're interesting in learning more about object-oriented design in general, and don't mind looking at a different language, an extremely good source is *Object-Oriented Software Construction* by Bertrand Meyer (Prentice Hall, 1988). This book illustrates discussions with the Eiffel language (which resembles a cross between Pascal and Ada). Although not useful for looking up C++ syntax (obviously), it has been invaluable in helping my mind shift into object-drive.

EXE

Laine Stump is currently suffering from back pains due to his habit of carrying a shoulder bag crammed with OOP books wherever he goes. The fact that his favourite computer book store is over 10,000 km from his house is suspected to be a major contributing factor to his ailment.

Laine can be reached via the PC Tech BBS at (0101-612-345-4656, evenings, US time) or by post at: Bilkent University, Lojmanlari 3/9, 06533 Bilkent / Ankara, TURKEY.

Desktop FORTRAN

EXPERTS AGREE WHAT TO BUY – THEY JUST CAN'T AGREE WHY!

"The FTN77 compiler has allowed us to port our main-frame applications to 386 micros with minimum effort. The speed of compilation is incredible! The run time performance is fantastic, full support for 32-bit operations and the 80387 coprocessor means our programs run like lightning!"

Tony Fitzpatrick, Exploration Consultants Ltd

"I find the FTN77/386 compiler to be fast and easy to use . . . We often download programs under development from a mainframe to the PC to run through this computer."

Rob McLaren
FTN77 386 User

"Without the FTN77/386 compiler it would have been totally impractical for us to convert our million-line + power system analysis program (PSS/E) to run on a 386 PC."

Wayne B'Rells
Power Technologies Inc

"FTN77/386 provides more intrinsic functions than any other functions to manipulate strings, handle screen and keyboard I/O, read the date and time, parse the command line. Advanced file manipulation functions allow an FTN77/386 program to work with files in a C-like manner"

Scott Ladd,
Computer Language, Nov 1988

I am very impressed and have decided to shift all our production programs over to FTN77 . . ."

Dr. G.R. Chapman
NCL Investments Ltd

"The ease of use, speed, debugging facilities, dynamic libraries with resulting small .EXE files, and extensive library routines made it a joy to use."

H. Gordon Jensen
FTN77/386 User.

"By far the fastest and most complete FORTRAN compiler that I have ever seen or used in the DOS environment."

Tim Wool
FTN77/386 User.

"The debugger was very easy to use. There is an on-line help facility which made reference to the manual unnecessary."

Mike Gunn and Arild Britto,
EXE Magazine, May 1989.

"For sheer speed and sleekness the (Salford) compiler stands out like a Ferrari among Yugos"

Jack W. Crenshaw, Computer Language, May 1990

FAST, FRIENDLY & FULLY FEATURED - THE PERFECT MIX - CALL US NOW!

SALFORD SOFTWARE LTD • VENABLES BUILDINGS • 5 COCKCROFT ROAD • SALFORD M5 4NT
TEL: 061 745 5678 • FAX: 061 745 5666

FTN77 386/486 – extending MS-DOS.

FULL WINDOWS 3.0 SUPPORT!

UNIX VERSION AVAILABLE TOO!

A WORLD OF

**The widest range
of software
is only a
phone call
away**



FAST - Federation Against Software Theft says £300m was lost by UK software publishers alone through piracy in the year to March 1990. Software Paradise support and encourage the ethical use of software. To report copyright violations call FAST on (0628) 660377



The Widest Selection of Applications and Development Tools Anywhere

**Place Orders Free on
0800-378-873**



Just Call Us - It's That Easy!

Why struggle with traffic? Why fight crowds? Just pick up the phone and say hello to the convenient way to buy ALL your PC software. Software Paradise Expressline is the fast, new distribution system for all of today's popular titles. Choose from the widest range of software available from any single source, all listed in our FREE 100-page Buyers' Guide. Place your orders FREE and the software will be despatched to you directly.

Software Paradise has supplied 100,000's of customers since 1986 and has fast become the U.K's leading software supplier. Our service is both convenient and affordable with up to 50% off manufacturers RRP's and the widest range anywhere!

Call us today and discover a World of Software!

Software Paradise®

MORE SOFTWARE THAN ANYONE ELSE!

Call 0222 887521 • Fax 0222 862209

SOFTWARE To Go!

Over 15,000 Software

Products for

DOS, Windows™,

OS/2®, Mac

& UNIX®

★ If you find an identical software product advertised in the national computer press by another mail-order company based in the U.K. at a legitimate, current price - tell us at the time of placing your order and we will happily BEAT that price and SAVE YOU MONEY! Join the 1000's of customers who have already benefited!

Don't forget - We'll BEAT Any Nationally Advertised Price! *

WHAT MAKES US DIFFERENT

- ✓ FREEPHONE 0800-378-873 Orders Only
- ✓ FREEPOST Mailing Address
- ✓ 24-Hour FAX Orderlines
- ✓ Up to 50% Discount On Over 15,000 Software Titles
- ✓ Pre-Sales Consultation
- ✓ FREE Post-Sales Technical Support
- ✓ Bulletin Board 0222 865551 (2400,8,N,1)
- ✓ CompuServe Mailbox 100015, 3570
- ✓ Unbeatable Prices *
- ✓ Next Day Delivery
- ✓ Huge Software Inventory
- ✓ FREE Literature Department
- ✓ Friendly & Knowledgeable Sales Staff
- ✓ VISA, ACCESS & Mastercard Accepted
- ✓ No Credit Card Charges Until Shipping
- ✓ Corporate P.O.'s Welcome
- ✓ Educational & Volume Discounts
- ✓ Latest Versions Guaranteed with Full Documentation & Manufacturers Warranties
- ✓ Over 6 Years Experience Providing the Very Best in U.K. and U.S. Software
- ✓ Stable & Secure Company with Impressive Track Record & Enviable Balance Sheet

Products shown in this advertisement represent only a small sample of our full range. Please specify Media Size when ordering. Goods are not offered on a trial basis. All our prices exclude Carriage & VAT.

All Trademarks & Registered Trademarks are hereby acknowledged

© Copyright '91/92 Software Paradise. All Rights Reserved.

Software Paradise, Avenue House, King Edward Avenue, Caerphilly, Mid Glamorgan, CF8 1HE

**FREEPOST
-TODAY-
NO STAMP NEEDED**



Please rush me my **FREE** copy of
'The Discerning Persons Guide to Software'

NAME _____

COMPANY _____

ADDRESS _____

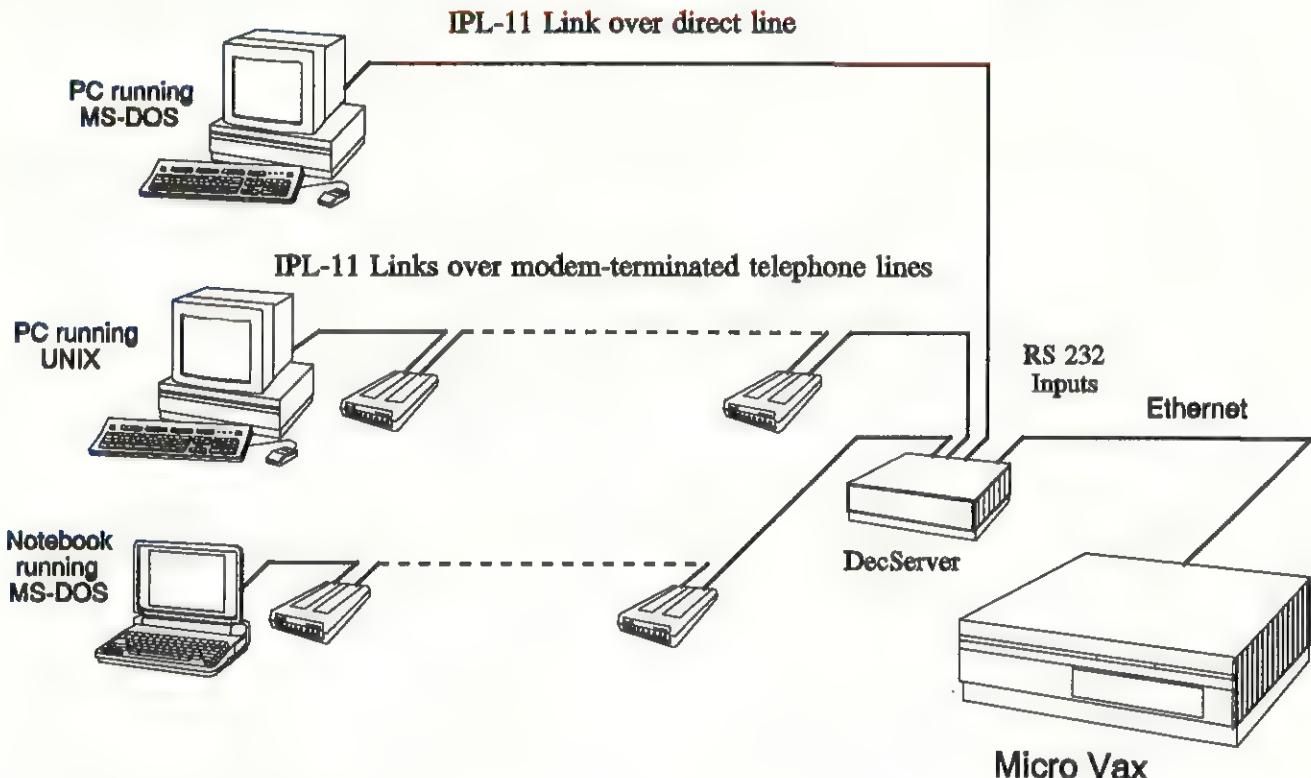
TEL _____

FAX _____

Mail to: Software Paradise, FREEPOST, Caerphilly CF8 1ZZ

EXE 3/92

File Transfer Software to link PC's, UNIX, VAXes and PDP-11s



The XOREN IPL-11 range of file transfer software packages allows simultaneous error-free file transfers between multiple PCs running DOS or UNIX and any VAX, PDP-11 or UNIX system. No special communications hardware is required. Each PC's comms port (com1, com2 etc.) may be connected directly or via a telephone line to a standard RS232 port on either a terminal server or the host computer

Since IPL-11 operates on a peer to peer basis, any PC, VAX, PDP-11 or UNIX system installed with IPL-11 can exchange files with any other PC, VAX, PDP-11 or UNIX system installed with IPL-11.

XOREN

Xoren Computing Ltd
28 Maddox Street
London W1R 9PF
Telephone 071-629 5932
Fax 071-629 5432



Efficient PC Serial Communications

Standard BIOS functions provide minimal support for serial communication.

John Davies shows how some general purpose assembly routines can greatly improve matters.

Two previous articles in *.EXE* magazine by Andrew Margolis - *The Thinking Programmer's Guide to UARTs* (Dec 1989) and *If I May Interrupt* (March 1990) - have covered in some detail the operation of the PC UART. The latter article developed code for a PC-based terminal emulator which would run under interrupts. To make full use of this code one further step is needed which is to develop general purpose software so that serial interrupt handlers can be included in applications programs. The

code should be callable from either assembly language or high-level languages such as C. This article takes the code for the terminal emulator and develops general purpose PC serial interrupt code.

Program Interfaces

The first decision to be made is what interfaces to provide for the applications program. The four obvious interfaces are: Start the serial interrupts, write a character to the

output buffer to be transmitted, read a received character from the input buffer and stop the serial interrupts.

Two other interfaces which will be useful are routines to return the number of characters currently in the transmit buffer awaiting transmission and the number of characters in the receive buffer which have not yet been read. The reason why these interfaces are useful will become apparent in due course.

```
*****  
; Serial port interrupt drivers  
*****  
NAME SERIAL PORT  
ASSUME CS: TEXT,DS: TEXT  
TEXT segment byte public 'CODE'  
*****  
; Public procedures  
*****  
PUBLIC start_serial_ints  
PUBLIC stop_serial_ints  
PUBLIC send_sio  
PUBLIC read_sio  
PUBLIC no_rx_chars  
PUBLIC no_tx_chars  
*****  
; Equates  
*****  
; Serial interrupt is no OCH  
comint EQU OCH  
; Base address of UART  
dataport EQU 03F8H  
; Interrupt enable register  
ierreg EQU dataport+1  
; Interrupt identity register  
iirreg EQU dataport+2  
; Line control register  
wordef EQU dataport+3  
; Modem control register  
modcont EQU dataport+4  
; Line status register  
statport EQU dataport+5  
; Modem status register  
modstat EQU dataport+6  
; Settings for RTS, DTR, OUT2  
set_lines EQU 00001011B  
; Settings for UART intrpt mask (rx,tx)  
int_setting EQU 00000011B  
; Settings to disable interrupts  
int_disable EQU 00000000B  
; Base address of PIC  
pic EQU 20H  
; PIC status register  
pic_stat EQU pic+1  
; End of interrupt command  
pic_eoi EQU 20H  
  
; Mask to enable interrupts in PIC  
int_mask EQU 11010111B  
; Size of receive buffer  
max_rx_buffer EQU 1FFFH  
; Size of transmit buffer  
max_tx_buffer EQU 1FFFH  
*****  
; Start serial interrupts  
*****  
start_serial_ints PROC FAR  
; Save registers  
PUSH BP  
PUSH DS  
PUSH AX  
PUSH DX  
PUSH BX  
PUSH ES  
; Get the required port setting  
MOV BP,SP  
MOV AX,[BP+16]  
; Load DS with the relevant value  
PUSH CS  
PUSH DS  
POP DS  
CALL set_port ; Set port parms  
CALL vectors ; Set up IRQ and  
CALL intson ; enable interrupts  
; Restore registers  
POP ES  
POP BX  
POP DX  
POP AX  
POP DS  
POP BP  
RET  
start_serial_ints ENDP  
; Set serial port  
; *****  
set_port PROC NEAR  
; Set up port to the parameters  
; defined in AL  
MOV AH,0  
MOV DX,0  
INT 14H  
  
RET  
set_port ENDP  
; Getting old, setting new interrupts  
; *****  
vectors PROC NEAR  
MOV AH,35H ; Get old irq  
MOV AL,comint  
INT 21H  
MOV oldint,BX  
MOV oldint+2,ES  
MOV DX,OFFSET service ; Get new irq  
MOV AH,25H ; Set vector  
MOV AL,comint  
INT 21H  
RET  
vectors ENDP  
; Activating interrupts  
; *****  
intson PROC NEAR  
XOR AX,AX ; Zero ptrs  
MOV nextin,AX  
MOV nextout,AX  
MOV charin,AX  
MOV charout,AX  
IN AL,pic stat ; Read PIC mask  
AND AL,int mask  
OUT pic_stat,AL  
MOV DX,modcont ; Set modem ctrl  
MOV AL,00001011B ; DTR,RTS,OUT2 on  
MOV flowin,AL ; Input flow ctrl  
OUT DX,AL  
MOV DX,modstat ; Modem status  
IN AL,DX ; Read it  
AND AL,00010000B ; Isolate CTS  
MOV flowout,AL ; O-put flow ctrl  
MOV DX,iirreg ; Int enable reg  
MOV AL,0000111B ; Enable all  
OUT DX,AL  
STI ; Enable ints  
RET  
intson ENDP  
;*****  
; Stop serial interrupts  
;*****
```

Figure 1 - Listing of serial port interrupt drivers (Continued overleaf)

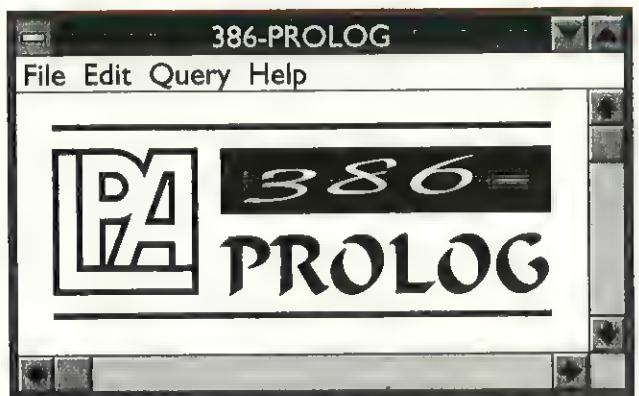
```

_stop_serial_ints PROC FAR
; Save registers
PUSH DS
PUSH AX
PUSH DX
; Load DS with the relevant value
PUSH CS
POP DS
XOR AL,AL ; Send 0 to int reg
MOV DX,1irreg
OUT DX,AL
MOV DX,oldint
MOV DS,oldint+2
MOV AH,25H
MOV AL,comint
INT 21H ; Restore old vec
; Restore registers
POP DX
POP AX
POP DS
RET
stop_serial_ints ENDP
; Interrupt service routine
; -----
service PROC NEAR
PUSH DS
PUSH AX
PUSH BX
PUSH DX
PUSH SI
PUSH CS
POP DS ; Data is in
; code space
again:
MOV DX,1irreg ; Int id reg
IN AL,DX
TEST AL,00000001B ; int pending?
JNZ endserv ; no = quit
MOV BX,OFFSET intab ; jump table
XOR AH,AH
AND AL,0000111B ; 16550 UART?
ADD BX,AX
CALL WORD PTR [BX] ; Service int
JMP again ; And loop back
endserv:
MOV AL,pic_eci ; end of int
OUT 20H,AL
POP SI
POP DX
POP BX
POP AX
POP DS
IRET
service ENDP
; Receive interrupt
; -----
rxint PROC NEAR
MOV DX,dataport ; Read UART
IN AL,DX
MOV SI,nextin
MOV BX,OFFSET inbuf ; Save data in
; circ buffer
MOV [BX+SI],AL
INC nextin
AND nextin,max_rx_buffer ; wrap around
rxpoll:
MOV DX,statport ; more data?
IN AL,DX
TEST AL,00000001B
JNZ rxint ; yes=deal
; with it
TEST flowin,00000010B
JZ end_rxpoll ; If RTS is
; already off
SUB SI,nextout ; bytes used?
AND SI,max_rx_buffer ; wraparound
CMP SI,max_rx_buffer-100H ; nearly full?
JB end_rxpoll ; No
MOV DX,modcont
MOV AL,00001001B ; RTS off
MOV flowin,AL ; Save RTS
OUT DX,AL
end_rxpoll:
RET
rxint ENDP
; Read character from input buffer
; -----
_read_sio PROC FAR
; Save registers
PUSH DS
PUSH BX
PUSH DX
PUSH CS
POP DS
; Load DS with the relevant value
PUSH CS
POP DS
XOR AX,AX
MOV SI,nextout
CMP SI,nextin ; Buffer empty?
JNZ read_buf ; Yes=return
MOV AX,100H ; Data invalid
JMP end_read
read_buf:
MOV BX,OFFSET inbuf
MOV AL,[BX+SI] ; Read data
INC SI
AND SI,max_rx_buffer ; Wrap around
MOV nextout,SI
TEST flowin,00000010B ; If RTS on
JNZ end_read ; Then exit
MOV BX,nextin ; Else check
; how much space
SUB BX,SI
AND BX,max_rx_buffer ; Wrap around
CMP BX,200H ; Getting empty?
JB end_read ; No=exit
MOV AH,AL ; Save data
MOV DX,modcont ; Modem ctrl
MOV AL,00001011B ; Turn RTS on
MOV flowin,AL ; Save RTS
OUT DX,AL
MOV AL,AH ; Restore data
MOV AH,0 ; Data valid
end_read:
; Restore registers
POP DX
POP BX
POP SI
POP DS
RET
_read_sio ENDP
; Transmmit interrupt
; -----
txint PROC NEAR
CMP flowout,0 ; If CTS off
JZ end_txint ; Don't send
MOV SI,charout
CMP SI,charin ; Check for
; data available
JZ end_txint
MOV BX,OFFSET outbuf
MOV DX,dataport
MOV AL,[BX+SI] ; Get data
OUT DX,AL ; And send it
INC charout
AND charout,max_tx_buffer ; Wrap around
end_txint:
RET
txint ENDP
; Put character in output buffer
; -----
_send_sio PROC FAR
; Save registers
PUSH BP
PUSH SI
PUSH DS
PUSH BX
PUSH DX
; Read character from stack
MOV BP,SP
MOV AL,BYTE PTR [BP+14]
; Load DS with the relevant value
PUSH CS
POP DS
MOV AH,0FFH
MOV SI,charin
MOV BX,SI
INC BX
AND BX,max_tx_buffer ; Wrap around
CMP BX,charout ; 1 space left?
JNZ send_char
MOV AX,0 ; No space=ret 0
JMP end_send
send_char:
MOV BX,OFFSET outbuf
MOV [BX+SI],AL ; Save char
INC charin
AND charin,max_tx_buffer
MOV AX,1 ; Char sent=ret 1
CMP SI,charout ; Buffer empty?
JNZ end_send ; Not empty=end
MOV DX,statport ; Line status
IN AL,DX
TEST AL,00100000B ; Transmit holding
; register empty?
; No-return
end_send:
; Restore registers
POP DX
POP BX
POP DS
POP SI
POP BP
RET
_send_sio ENDP
; Modem status interrupt
; -----
modint PROC NEAR
MOV DX,modstat ; Modem status
IN AL,DX ; Read it
TEST AL,00000001B ; CTS changed?
JZ end_modint ; No-ignore
AND AL,00010000B ; Isolate CTS
MOV flowout,AL ; Save as flag
JZ end_modint ; Resume if on
JMP txint
end_modint:
RET
modint ENDP
; Line status interrupt
; -----
exit PROC NEAR
MOV DX,statport ; Status port
IN AL,DX ; Clear by
; reading line
status:
RET
exit ENDP
; *****
; Calculate no of chars in output buffer
; *****
_no_tx_chars PROC FAR
; Save register
PUSH DS
; Load DS with the relevant value
PUSH CS
POP DS
; no of tx chars =
; (head ptr - tail ptr) AND max_tx_buffer
MOV AX,charin
SUB AX,charout
AND AX,max_tx_buffer
; Restore register
POP DS
RET
_no_tx_chars ENDP
; *****
; Calculate no of chars in input buffer
; *****
_no_rx_chars PROC FAR
; Save register
PUSH DS
; Load DS with the relevant value
PUSH CS
POP DS
; no of rx chars =
; (head ptr - tail ptr) AND max_rx_buffer
MOV AX,nextin
SUB AX,nextout
AND AX,max_rx_buffer
; Restore register
POP DS
RET
_no_rx_chars ENDP
; Data area for subroutines
; *****
nextin dw 1 dup (?) ; inbuf head ptr
nextout dw 1 dup (?) ; inbuf tail ptr
charin dw 1 dup (?) ; outbuf head ptr
charout dw 1 dup (?) ; outbuf tail ptr
flowin db 1 dup (?) ; inbuf
flowout db 1 dup (?) ; outbuf
inbuf db max_rx_buffer dup (?) ; inbuf
outbuf db max_tx_buffer dup (?) ; outbuf
; Jump table for int service routine
intab dw modint ; Modem status
dw txint ; Tx interrupt
dw rxint ; Rx interrupt
dw exitint ; Ext / status
oldint dw 2 dup (?) ; Old int vec
_TEXT ENDS

```

Figure 1 - Listing of serial port interrupt drivers (Continued)

Windows 3!



Yes, it's here! LPA 386-PROLOG is now available in a version for Windows! Just like the DOS-extender version, it is a genuine 32-bit Prolog compiler which can directly access up to 4G (4096M) of memory. Only this time, it is fully integrated with the world's most popular GUI: Windows 3!



Logic Programming Associates Ltd
Studio 4, Royal Victoria Patriotic Building
Trinity Road, London, SW18 3SX, England
Tel: 081 871 2016 - Fax: 081 874 0449

CIRCLE NO. 581

Looking to add TCP/IP network access to your system designs?

Now you can incorporate the industry standard TCP/IP protocol suite in your system designs with *FUSION Developer's Kit*.

Designed for the OEM and systems integrator, *FUSION Developer's Kit* provides the full TCP/IP protocol suite including TELNET (virtual terminal), FTP (File Transfer Protocol), and R-Commands.

FUSION Developer's Kit also has a flexible C-source code architecture, making it processor and operating system independent.

Currently used in hundreds of process control, embedded systems, and end-user designs, *FUSION Developer's Kit* from Network Research comes with full support and porting services.

 **Network Research**

CIRCLE NO. 583

INNOVATIVE DESIGN TOOLS FROM GREAT WESTERN INSTRUMENTS

Great Western Instruments are the specialists in innovative design tools for the real-time systems developer. Our services include full technical and design consultancy support for all our products.

THE PROFESSIONAL SUPPLIER

We know as product developers that real-time software designers expect quality support from their suppliers. We supply some of the finest design tools and language products available and, unlike many suppliers are prepared to back them with full technical support. Join our existing very satisfied customers who regularly benefit from our expertise.

PRODUCTS AND SERVICES

- SELECT Software low cost CASE tools for Yourdon, HOOD and SSADM
- SMS software management system for MSDOS, OS/2, UNIX and VMS
- Embedded DOS, the MSDOS v3.31 compatible operating system with multi-tasking
- AMX Executives for the 80x86, 80386, 68000 and Z80 from KADAK
- Memory management tools to support EMS, XMS and virtual memory
- The Annabooks range of BIOS kits, PROMKIT and customised keyboard software

BORLAND Authorised Dealer with language expertise
Authorised **BORLAND** language UPGRADE centre

AUTHORISED UPGRADE CENTRE

GREAT WESTERN

*-Understanding the needs
of other designers!*

For immediate information about these & other products in our range, use your Fax/Telephone to call Facts-direct (0865) 727232, item 444401



Unit 1m Farrington Fields
Farrington Gurney
Bristol BS18 5UU
Tel 0761 452116
Fax 0761 453226
VAT Extra Carriage Free
All trademarks acknowledged

CIRCLE NO. 582

FUSION

For a *FUSION Developer's Kit* information package, including data sheet, technical specifications and licensing plans, call 0489-583212 or FAX 0489-885923

Network Research, UK

37 Hazel Grove, Locks Heath Southampton

Hants SO36Sh, England

CIRCLE NO. 583

Program Notes

Before considering the code in detail a few points should be noted.

First, the Turbo C V2.0 subroutine calling conventions have been used throughout when passing parameters to or receiving parameters from subroutines. These conventions will also need to be observed when using these routines with assembly language. The Turbo C manual gives full details of these calling conventions but briefly parameters are passed into a subroutine on the stack and any value returned

from a subroutine is returned in the AX register. The calling routine is also expected to clean up the stack after the subroutine returns.

Secondly the original terminal emulator code has been modified so that input and output buffers are now 8 KB each.

Thirdly all the routines accessible to the applications program have been declared as FAR routines. This is so that they can be used with all compiler models without modification. Declaring these routines as FAR adds a small but negligible overhead to the interrupt response time.

is full then the character is discarded. An integer parameter is returned from this routine indicating whether the character was successfully inserted into the buffer (1 = character sent, 0 = character not sent).

The routine to read a character from the input buffer is also very similar to the terminal emulator except for the way in which the data is returned. The terminal emulator used the carry flag to indicate whether there was valid data available or not. This is not really feasible for a high level language so an integer is returned instead. If the high byte of the integer is zero then valid data is available in the low byte of the integer. If the high byte is non-zero then no valid data is available. This could be expanded to return error codes in the high byte if, for example, a character was received with an error. The Turbo C function prototype for this function is

```
int read_sio( void )
```

Calculating characters

Calculation of the number of characters awaiting transmission (`no_tx_chars`) requires the use of the head and tail pointers of the transmit buffer. The returned value can be very useful if there is a need to write a large number of characters in one block to the buffer. It would be possible to write each character in turn and check the return value but it is much simpler to check the space available first before starting to write.

Calculating the number of characters in the receive buffer (`no_rx_chars`) is very similar to the previous one. This is very useful where the communications are packet-based as the applications software can wait for a particular number of characters to be received before starting any processing.

Finally

Figure 2 is a simple terminal emulator written in assembler. Even if you don't understand UARTs, the code presented in Figure 1 should make a useful library module which can be called from high-level languages that can use C calling conventions.

586

The Turbo C function prototype for this function is:

```
void stop_serial_ints( void )
```

Reading and writing

Writing involves passing a character to the `send_sio` routine which is put into the output buffer. If the buffer is empty then the character is written to the UART and the serial interrupts started. If the output buffer

John Davies has worked for several years in a variety of real time embedded software applications. The code accompanying this article is available on disk. Send a blank formatted floppy disk to the Editor, following the instructions given on Page 1, column 1. Mark your envelopes 'PCSERIAL'.

Figure 2 -
Terminal emulator in assembler

Deskterm™

Discover how you can add a Motif Interface onto Character-based Applications.

YOUR RECIPE FOR
COOKING TIME

90% saving on re-writing your
software for X

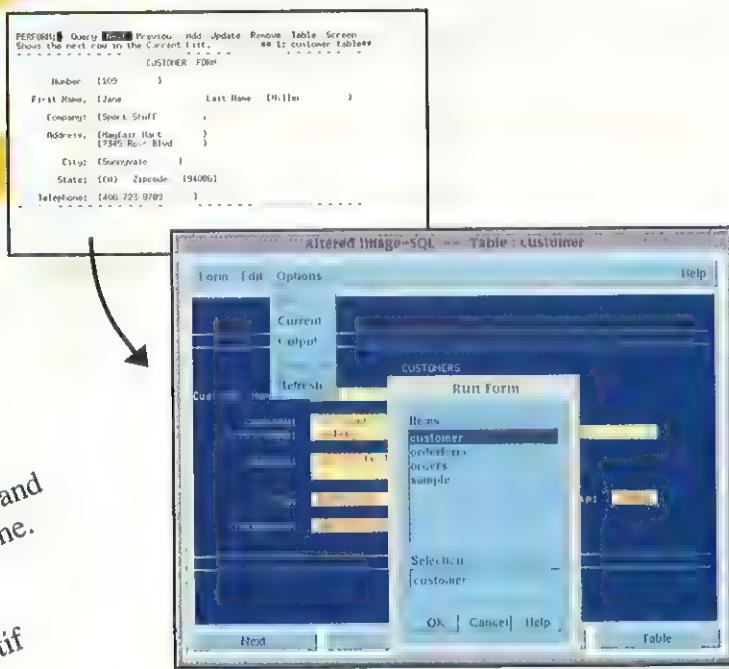
METHOD

Take existing
character-based application

Add IXI's Deskterm
Software.

Run on UNIX system and
simmer for a short time.

Before serving,
decorate with Motif



Like many software developers, you may be evaluating how to produce a Motif version of your application. It's no easy decision. For many businesses, the task of rewriting a 20 year old COBOL application or one written in FORTRAN or a 4GL is too costly in terms of time and resources.

IXI has the answer. Deskterm will revolutionize your path to Motif. Experience shows that Deskterm can reduce the time to add a Motif front-end by more than 90%, bringing your application to market years ahead of the competition.

Using Deskterm you can produce a fully featured graphical user interface with pull down menus, scroll bars, dialog boxes, pushbuttons, mouse control and

multiple fonts and colors. What's more, you can do all this without access to the application's source code.

You don't need to know anything about X programming (at either Xlib or toolkit level) to move your software to Motif. Deskterm uses existing character-based programming skills allowing you to concentrate your time and money on building applications rather than wrestling with X and toolkits.

So if you're looking for a fast and painless route to Motif, contact us today for information on +44 223 462131.

UNIXWORLD
1.8.8.0
BEST
PRODUCTS

IXI

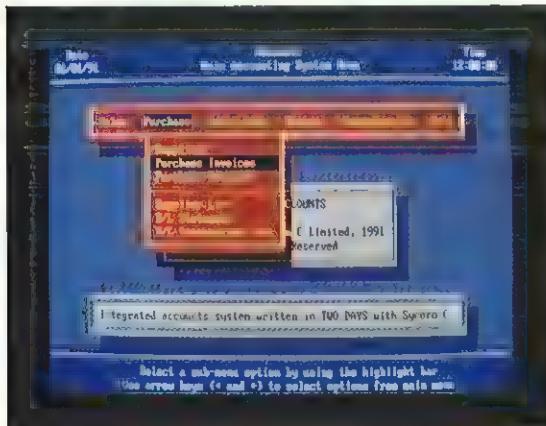
VIA

IXI Limited · 62-74 Burleigh Street · Cambridge · CB1 1QJ · England · Tel: +44 223 462131 · Fax: +44 223 46132

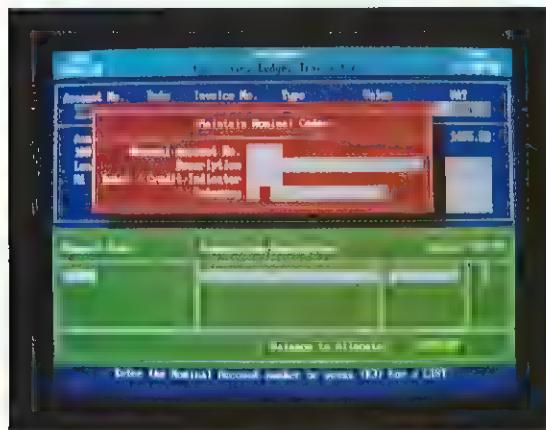
Deskterm, IXI and the IXI logo are trademarks or registered trademarks of IXI Limited

CIRCLE NO. 584

Software Developers!



...Here's the same application half an hour later using Turbo C++'s advanced VROOM technology...



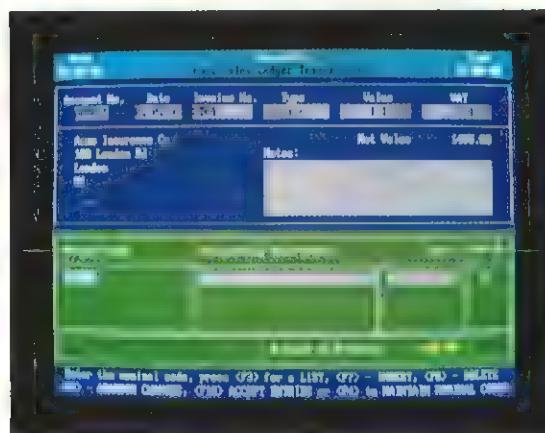
...and here's the same application an hour later running under SCO UNIX, with no runtime licences required !

This entire application was developed in a couple of days using Sycero C. Sycero is a powerful program generator that dramatically reduces your programming time. Sycero C generates fully structured and documented C source code to be compiled with Microsoft or Turbo C. Sycero C supports the Btrieve/C-ISAM file handling systems, plus it can even generate C programs for use with dBASE or Clipper files and indexes. Sycero C UNIX allows you to develop software to run under SCO UNIX, and you can regenerate existing Sycero C DOS-based applications with absolutely no changes required to your definitions.

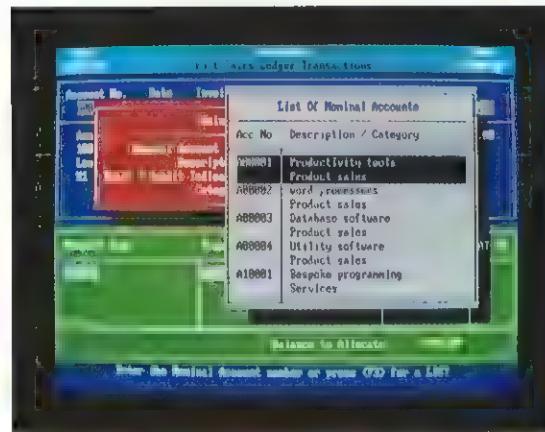
For more information, either call us on 0622 691616, or fill out and return the coupon.

CIRCLE NO. 585

Produce a sophisticated application like this in Microsoft C, with either BTRIEVE or C-ISAM, running under DOS in just a couple of days!



...Another twenty minutes and it can access dBASE files...



Please send me further details about Sycero C

Name:

Company:

Address:

.....

.....

Tel: Fax: EXE 3/92

I am also interested in your generator for Clipper, Sycero dB

System C Ltd 60-61 High Street Maidstone Kent ME14 1SR

Tel 0622 691616 Fax 0622 691241

More Paradoxes

Larry Adlard blows the lid on Paradox's proprietary file system.

One of the components of many systems we write is a high speed real time order entry program. When a customer phones in, the person he talks to has on screen all the details of his account, access to all stock records, and the customer's past history. The intention is to take the order there and then, with delivery notes, invoices and any other documentation being produced within a few seconds. All records are updated and the job is completed in one pass.

Paradox is a fine product but, unfortunately, the world is not perfect and in spite of my full and enthusiastic recommendation, Paradox has its limitations. When it comes to the kind of speed we sometimes need, Paradox just simply can't cut it. That's not a criticism, just a recognition of reality. What that means is that the front end of the system is going to be written in another language and in our case it will be assembler.

Mixing two 'languages' can cause complications but in our case the assembler program is one standalone thing. The data it operates on is maintained in and by the Paradox system. This means the format of the data can be rearranged by the customer, data can be added and deleted and the assembler program adapts to the revised data format.

The crux is that in order to work this way you have to know how Paradox organises its files and as far as I know this information is not published anywhere. Borland (née Ansa) keep the method confidential. If you already write in C, then Borland will now sell you a library of routines for access, but this was not available in 1987 when we needed it and we don't particularly wish to write in C. If you can accommodate the Paradox Engine then this may be your best solution and you will note that I am bending over backwards to point out the alternatives before encouraging you to try and manipulate Paradox files directly. We don't go out of our way to break the rules, but needs must when the devil drives.

If despite the alternatives, you find yourself in a similar position to ourselves, then the following information will allow you to read and write data reliably, to and from Paradox files, subject to the following house rules.

DO NOT attempt to create or extend Paradox files. Let Paradox create its own file and pre-format as many records as you are likely to need. If necessary store records in a temporary Paradox file and let Paradox append these to the main database.

DO NOT attempt to maintain indexes or password encrypted files unless you are a masochist.

Paradox files are similar in principle to dBASE files, ie the data file is self documenting. The data is preceded by a header which encapsulates all the information required to decode it. There the similarity ends. Using DOS debug, anyone can inspect a Paradox file but remember debug loads the file at 100h for execution as a program, so all the address references are inflated by 100h. Figure 1 shows the file as it is. The Paradox structure is shown in Figure 2.

The first word is in standard Intel, low-byte first format and represents the length of the record (0066h) = 102 decimal bytes in this case.

The second word is the address where the data actually starts (0800h).

The third word is marked in our files as the unknown soldier; every file we've seen has the value (0202h). Since we don't remember and no longer have access to any Paradox version 1 files, we suspect but cannot confirm that this represents a version number.

The fourth word (01ECh) is the current number of records stored (492).

The fifth word has no use known to us.

The sixth word gives the file length in Paradox blocks or packets (26).

Moving on, the 34th byte (021h) gives the number of fields. One byte is large enough because 255 is the maximum.

If at this point you are operating legally, have access to Paradox, and have created the file you have almost everything you need. The only other aspect you need to know about is the technique which Paradox uses to place records into packets which is described later. In case you need a little more detailed information, a brief discussion of the descriptors follows.

Curiouser and Curiouser

At location (0030h) there are two four-byte patterns. These are not relevant until after you understand the field descriptors but the patterns they form should be noted. Field descriptors start at (0058h). These are two-byte pairs. The first byte indicates what type of field it is (See Figure 3), the second byte gives the field length in bytes (again maximum 255). With the exception of Alpha-Numeric Fields all the other types have a predefined length. A record can have between 1 and 255 fields, therefore the area which contains the field descriptors can vary in length from 2 to 510 bytes. In the example shown there are 18 fields, so the field descriptors are 36 bytes long. Following immediately after this is a four-byte pattern followed by another 18 four byte patterns. These are similar to the other two noted earlier.

The first four-byte pattern after the field descriptors is a pointer to the Filename at location (00C8h). The next one points to field heading 'Carma' at the location (011Fh). This is the name that Paradox knows that field by. The remaining four-byte blocks each point in turn to the next fieldname until all fields have been named. Immediately following that is the Filename.

By now the four-byte pointers may be puzzling you since they do not point directly to the data addresses in your file. The values are so large that their point of origin is way outside the data file. Bearing in mind that Paradox files are intended to be accessed from within the Paradox program (and without any authority whatsoever) we might speculate that these are an offset from a fixed data location within the Paradox program itself. All is not lost however, the difference is a constant. You will note that the last two bytes are common throughout and can therefore be ignored

altogether. The first two bytes when added together also do not directly point to the data they represent but the error is now much smaller. For example the pointer to the Filename (007Ch) reads 3E 8E 77 1B. Adding the first two bytes together, the result is (3E+8E=CC) but the Filename isn't located at CCh, it is located at C8h, a difference of four. Now that you know the first two bytes are wrong by a displacement of four, lets try the next block. This reads 8D 8E 77 1B. Adding 8D to 8E gives 11Bh less the four bytes constant error gives 117h. Lo and behold we have calculated the offset

from the beginning of the file to the name of the first field. Once the difference has been established it can be applied to each pointer in turn until all the field names have been recovered.

Even if the Filename wasn't visible it is possible to obtain its address. The file descriptors start at the fixed offset 0058h. The byte at 0021h gives the number of fields and each field has a descriptor that is two bytes long. Beyond that area there is a block of four-byte pointers to each field title plus a four-byte pointer to the Filename. Given N fields, the address for the start of the Filename can be calculated from: $0058h + ((2^N) + ((N+1)*4))$. This value can be compared to the Filename pointer to obtain a correction factor which then allows you to find the field names, which because of the variable length of the field descriptors, could be anywhere.

Unless you are going to write a better utility for reading Paradox files than the people who wrote Norton Commander, you won't need most of this information. If it is your file you will already know what the fields are, and what type and size they are. You will however need to know how Paradox places records into packets, as described later.

Paradoxical Packets

It always used to be our practice to try and make record lengths binary multiples such as 16/32/64/128 bytes. The reason is purely practical and dates from when computers were much less powerful. Hard disks don't read records, they read sectors of 256 or 512 bytes. DOS reads multiple sectors into blocks. If you have an 'odd' length record of say, 117 bytes, then depending on sector size and block size a record will eventually straddle a block or sector. The performance penalty is that two blocks or sectors have to be read to obtain first one portion of the record and then the remainder from a second block. Depending on the way the machinery has been configured it could take 3 or 4 times as long to retrieve that record.

The designers of Paradox obviously despairing of efforts to persuade application programmers to write 'even' length records arranged to store records in packets. This practice can work against efficient storage unless you are aware of it. A data packet can be 1 KB, 2 KB or 4 KB long and which size it is depends on the record length.

The first six bytes of each packet are used for important housekeeping functions which are explained later. If say, your record is 128 bytes long and Paradox chooses

| Addr: | H E X | ASCII | DECIMAL |
|-------|-------------------|--|-------------------------------------|
| 0000: | 66 00 00 08 02 02 | EC 01 h | [0102] [2048] [0514] [0492] |
| 0008: | 00 00 1A 00 1A 00 | 01 00 | [0000] [0026] [0026] [0001] |
| 0010: | 1A 00 23 00 00 00 | ..#.... | [0026] [0035] [0000] [0000] |
| 0018: | 00 00 32 03 6F 1B | 00 00 ..2.o... | 0 0 050 003 111 027 0 0 |
| 0020: | 00 12 00 00 00 00 | 00 00 .. | [0118] 0 0 0 0 0 0 |
| 0028: | 00 B7 00 00 00 7B | 7A 00 ..z, | 0 183 0 0 0 123 122 0 |
| 0030: | F2 8D 77 1B C8 | 8D 77 1B ..w...w. | 242 141 119 027 206 141 119 027 |
| 0038: | 00 04 1A 00 00 00 | 1F 0F | 0 004 026 0 0 0 0 031 015 |
| 0040: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 0048: | 00 01 00 00 00 00 | 00 00 .. | 0 001 0 0 0 0 0 0 |
| 0050: | 00 76 01 00 00 00 | 00 00 ..v.... | 0 118 0 0 0 0 0 0 |
| 0058: | 01 08 01 01 20 01 | 01 .. | [001] 008 001 001 001 032 001 001 |
| 0060: | 05 08 05 08 05 08 | 05 08 | [005] 008 005 008 005 008 005 008 |
| 0068: | 03 02 03 02 03 02 | 02 | [003] 002 003 002 003 002 003 002 |
| 0070: | 06 08 06 08 01 01 | 01 .. | [006] 008 006 008 001 001 001 001 |
| 0078: | 03 02 01 02 3E 8E | 77 1B ..>..w. | [003] 002 003 002 062 142 119 027 |
| 0080: | 8D 8E 77 1B 93 8E | 77 1B ..w...w. | 141 142 119 027 147 142 119 027 |
| 0088: | 95 8E 77 1B 98 8E | 77 1B ..w...w. | 149 142 119 027 155 142 119 027 |
| 0090: | A0 8E 77 1B A6 8E | 77 1B ..w...w. | 160 142 119 027 166 142 119 027 |
| 0098: | AC 8F 77 1B B2 8E | 77 1B ..w...w. | 172 142 119 027 178 142 119 027 |
| 00A0: | B8 8E 77 1B BE 8E | 77 1B ..w...w. | 184 142 119 027 190 142 119 027 |
| 00A8: | C4 8E 77 1B CA 8E | 77 1B ..w...w. | 196 142 119 027 202 142 119 027 |
| 00B0: | D0 8E 77 1B D6 8E | 77 1B ..w...w. | 208 142 119 027 214 142 119 027 |
| 00B8: | DC 8E 77 1B DE 8E | 77 1B ..w...w. | 220 142 119 027 222 142 119 027 |
| 00C0: | E0 8E 77 1B E6 8E | 77 1B ..w...w. | 224 142 119 027 230 142 119 027 |
| 00C8: | 52 45 53 54 54 45 | 4D 50 RESTTEMP R | E S T T E M P |
| 00D0: | 2E 44 42 00 00 00 | 00 00 ..DB.... | D B 0 0 0 0 0 0 |
| 00D8: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 00E0: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 00E8: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 00F0: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 00F8: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 0100: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 0108: | 00 00 00 00 00 00 | 00 00 .. | 0 0 0 0 0 0 0 0 |
| 0110: | 00 00 00 00 00 00 | 43 ..C | 0 0 0 0 0 0 0 0 C |
| 0118: | 61 72 6D 61 50 44 | arrna.T.D a | r m a . T . D |
| 0120: | 65 73 63 72 00 50 | 61 63 escr.Pac | |
| 0128: | 6B 00 42 61 6E 64 | 31 00 k.Band1. | |
| 0130: | 42 61 6E 64 32 00 | 42 61 Band2.Ba | |
| 0138: | 6E 64 33 00 42 61 | 6E 64 nd3.Band | |
| 0140: | 34 00 41 76 61 | 69 6C 00 4.Avail. | |
| 0148: | 52 65 73 76 64 00 | 4F 4E Resvd.On | |
| 0150: | 4F 72 64 00 53 74 | 4D 69 Ord.StM1 | |
| 0158: | 6E 00 42 61 53 65 | 50 00 n.BaSep. | |
| 0160: | 43 6F 73 74 50 00 | 58 00 CostP.X. | |
| 0168: | 59 00 54 72 43 6E | 74 00 Y.TrCntr. | |
| 0170: | 53 70 61 72 65 00 | 00 00 Spare... | S p a r e 0 0 0 0 |
| 0178: | 00 00 00 00 00 00 | 00 .. | 0 0 0 0 0 0 0 0 |
| 0800: | 02 00 00 00 92 07 | 31 30 ..,10 < 6 byte header followed by 1st Record | |
| 0808: | 30 31 46 31 42 4B | 54 53 01FBKTS A8 + A1 + A32 | |
| 0810: | 50 4F 4F 4C 45 44 | 20 31 POOLED 1 | |
| 0818: | 30 4D 20 42 4C 41 | 43 4B OM BLACK | |
| 0820: | 00 00 00 00 00 00 | 00 00 ..< Note padding of Alpha string with 0 | |
| 0828: | 00 00 00 00 00 00 | 00 40 L < Line ends with A1 Alpha field | |
| 0830: | BF E4 7A E1 47 | AB 14 7B ..=p...< All 8 bytes are a currency value | |
| 0838: | BF E7 0A 3D 70 | A3 D7 0A ..=p...< ditto | |
| 0840: | BF E4 7A E1 47 | AB 14 7B ..z.G..t ditto | |
| 0848: | BF E3 33 33 33 33 | 33 33 33 33 33 ditto | |
| 0850: | 80 08 80 00 80 00 | 80 90 ..< 4 x 2 byte short integers | |
| 0858: | BF DA 7E F9 DB 22 | D0 E5 ..".." < All 8 bytes are a numeric value | |
| 0860: | 00 00 00 00 00 00 | 00 00 ..ditto | |
| 0868: | 00 2A 00 00 31 30 | 30 31 .*.1001 < 2 x flags + A2 Spare + Next Record | |
| 0870: | 46 31 42 52 54 53 | 50 4F F1BRTSPO | |
| 0878: | 4F 4C 45 44 20 31 | 30 4D OLED 10M | |

Figure 1 - A memory dump of a Paradox file header



How much longer can you afford to wait?

Create Overlaid Programs-Fast.

BLINKER™, the world's first and fastest dynamic overlay linker, reduces your link time to seconds and reduces program memory requirements. Now you can use one linker for all your software projects.

One Linker, Many Languages.

BLINKER 2.0 links and automatically overlays DOS programs written in Microsoft® C, BASIC, Assembler, QuickBASIC™, Fortran, Pascal, Watcom™ C, Zortech C++, Clipper®, FORCE® and in Borland® C, C++, Assembler, and more.

Save Time and Memory.

BLINKER removes the need for overlay structures, simplifies program design and reduces memory requirements to save you time, effort and memory.

Memory Swap Function.

BLINKER is the ONLY linker to offer an integrated memory swap function, so you can run other large programs from within your program, with negligible memory overhead.



BLINKER™
High Performance Dynamic Overlay Linker

Don't Settle for Less.

Other major features include full CodeView® support, use of EMS/XMS at program run-time, and enhanced execution speed of overlaid code.

Time is Money.

BLINKER offers all this in a fraction of the time it takes to link with your current overlay linker. You know time is money, and link time is no exception.

Free Demo

To try our free demo on your own code and for more information contact our U.K. distributor:



Call: +44-81-994-4842 or
FAX: +44-81-994-3441

QBS Software Ltd.
10, Barley Mow Passage
London W4 4PH

BLINKER is available in 5.25" or 3.5" diskette format

Price £199
plus shipping & handling



Blinkinc
P.O. Box 7154
Richmond VA
23221

| STRUCT | Field Name | Field Type | |
|--------|------------|------------|--|
| 1 | Carma | A8 | This is the product code |
| 2 | T | A1 | Flag for internal manufacture |
| 3 | Descr | A32 | Full description |
| 4 | Pack | A1 | Pack type |
| 5 | Band1 | \$ | } |
| 6 | Band2 | \$ | } Banded |
| 7 | Band3 | \$ | } Prices |
| 8 | Band4 | \$ | } |
| 9 | Avall | S | Qty available for sale |
| 10 | Resvd | S | Qty reserved |
| 11 | OnOrd | S | Qty on order |
| 12 | StMin | S | Stock Minimum |
| 13 | BaSeP | N | Base Price (minimum selling price) |
| 14 | CostP | N | Cost Price |
| 15 | X | A1 | Flag to indicate a price change |
| 16 | Y | A1 | Flag to indicate Stock Minimum warning |
| 17 | TrCntr | S | Transaction count |
| 18 | Spare | A2 | Example of our internal padding |

Figure 2 - The Paradox Structure Table

a packet size of 2048 bytes then you would expect each packet to contain exactly 16 records but Paradox needs 6 bytes of each packet and it NEVER, NEVER allows a record to straddle two packets. What you will get for your 2 KB is a six byte header 15 complete records and a wasted area of padding 122 bytes long. If on the other hand your record is 127 bytes long you will get the 6 byte header 16 records and only 10 bytes of padding. The worst cases occur with really long records. (See Andy Redfern's article *Performance Tuning Paradox* - .EXE April '91.)

Paradox effectively trades disk space for speed if you choose an inappropriate record length. Paradox's true love is exactly 15 bytes long, unfortunately not many customer names and addresses fit easily into this length, so sometimes a compromise has to be struck.

You will note that the record length in this case is 102 bytes long. Using our previous system of binary multiples this would be terrible. Paradox will place records of this length into 2 KB packets so in a 2048 byte packet it will fit 20*102 byte records (2040) plus a six byte header and only two bytes will be wasted. Every DOS read retrieves 20 records.

Christie Thriller

If you have followed every detail so far you may be grateful to reach the end. Like an Agatha Christie novel, there is one more little twist. The six byte header at the beginning of each packet is actually three words. The first word is a pointer to the packet (the packet number) which contains the next record. The next word is a pointer to the packet which contains the record previous to the first in the current packet. The third word is a pointer to the beginning of the last

valid record in the packet. (Packet zero is the header.)

Observing the specimen file, the first word (0800h) has the value two. Since all the records were entered sequentially, this is as one might expect. The first packet contains 20 records and the 21st record is the first record in packet number two. If we delete record number two all the records after number two in the first packet are promoted 3>2 4>3 etc. The third word in the header is reduced by one record length (0792h-66h=072Ch) and the number of records at (0006h) is reduced by one. A copy of the record which was at position 20 in the packet and was copied forward to position 19 remains in position 20 but never appears in Paradox because the byte count in the third word of the packet header stops Paradox from reading beyond the 19th record.

Assuming the file is returned to its previous state consider what happens when a record is inserted. We insert a new record at two. All the records will be demoted this time by one position but the packet can only contain 20 records so the record previously at position 20 will now 'fall off' the end of packet one. There are two possible ways of dealing with this. The first solution is to continue demoting every record in the file until the whole file has been extended. You will be sorry to learn that Paradox doesn't do that. Paradox creates an entirely new packet and increments the packet count at location (000Ah). Since there are 26 packets already, the new packet is appended to the end of the file. The three words at the beginning of the new packet will read 0001h 0002h 0000h. The first word indicates that the previous record is the last valid record in packet number 1. The second word tells you that the next record in the sequence (after all the records in this

packet) is the first record in packet number two. The third word indicates that only one record is present in this packet since the last record in the packet starts at offset 0000 (+6 bytes for header). In effect, when a packet is full and a new record is inserted, the overflow is placed into a new packet which forms a semi-'B Tree' like structure. From now on this new packet is reserved for overflow from packet number one. Paradox does not fully initialise the new packet. If you look at it you will see the six byte header of the record and the remainder of the 2 KB may be garbage. Alternatively, it may contain the .BAK version of the managing director's reply to Personnel, regarding your request for a raise.

If you now delete the recently inserted record number two, all the records in packet number one will be promoted again but the overflow record in packet 27 will not be moved back to block 1, it will remain where it is. As you add records the file gets longer. If you delete records the space is left vacant. Empty nodes are not permitted, so the file never gets shorter. I know of only one way you can recover space from, or defragment a Paradox file. You have to create a new file with an identical structure to the old one and read the records one by one from old to new. You can then delete the old and rename the new to the old name.

It may not have escaped your attention that the file is empty between locations 0200h and 07FFh. Partly this is to make the header up to packet size but do not be misled into thinking it might be available for your use. In certain circumstances Paradox does use this area and if it does, the methods outlined here are likely to be entirely inappropriate. The value at (0030h) does in fact point to a location in this area which ensures that the field titles will not be overwritten.

Without giving any secrets away, you might be aware that Paradox files can be password encrypted. The techniques outlined above will not enable you to circumvent this protection, nor would we publish a

| No | Type | Length |
|----|---------------|----------|
| 1 | Alpha-numeric | 1 to 255 |
| 2 | Date | 4 |
| 3 | Short | 2 |
| 4 | Long Integer | 4 |
| 5 | Currency | 8 |
| 6 | Numeric | 8 |

Figure 3 - Paradox field types

VISUAL INTERFACE

GUI Library for Clipper

We led the way with dGE. This is the other indispensable library for Clipper. For the first time your Clipper programs can have the look and feel of a Windows application.

Visual Interface has it all....

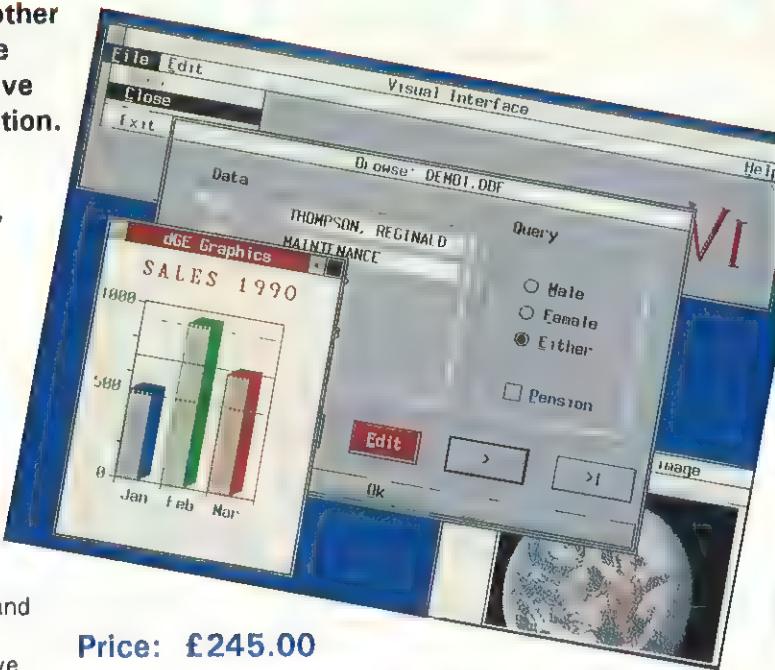
- Multiple windows that can be moved, sized, maximized and minimized
- A complete range of interactive controls
- An integrated event handler
- Simple to program
- Fully object-orientated
- Runs dGE graphics in its windows

Your applications will never be the same....

- Create graphical dialog boxes, data-entry forms and context-sensitive help screens
- Select files from scrolling list boxes
- Import bit-mapped images
- Create queries using icons, radio buttons, and check boxes
- Run several windows concurrently and move between them with a keystroke or mouse-click

VI comes with a 250 page manual including over 100 pages of tutorial with examples.

Requires: Clipper 5.01
DOS 3.x or higher
640K RAM
EGA or VGA



Price: £245.00

From: Bits Per Second Limited
14 Regent Hill, Brighton, E.Sussex BN1 3ED
Tel. 0273 727119 Fax 0273 731925

The VI library contains elements of Classy! and SuperClass issued under licence. You do not need to buy these products to use VI with Clipper 5.01
Classy! (c) Anton van Straaten
SuperClass (c) Chydale Software
dGE, Visual Interface (c) Bits Per Second Ltd.

CIRCLE NO. 587

LOOK at all OPTIONS.

Software Protection - but which TYPE ?

• EVERKEY II - The Hardware Option?

SINGLE WIRE ZERO LOAD - Total Compatibility.
Not available in ANY other Key product.



• EVERLOCK - The Software Option?

Software-Only Copy Protection; economical & SECURE.

• EVERTRAK - Non Copy-Protection Option?

Non Copy-Protection - Anti Hacker software protection.

CALL FOR A FREE WORKING DEMO DISKETTE

Other Services include:- Disk Duplication & supply - Label Production & supply - Packaging.



USER FRIENDLY

22A, Bartleet Road,
Washford Industrial Estate,
Redditch, Worcestershire,
B98 0DG. England.
Tel: 0527 510 105
Fax: 0527 514 229

..... THE ONLY OPTION.

Sole Distributor for Az-Tech Software, Inc. - UK, Ireland & Spain.

CIRCLE NO. 588

5 out of 5 hackers prefer other software protection methods to Hardlock E-Y-E®



What hackers dislike...

Hardlock E-Y-E was designed using cryptographic principles. It took the experience and know-how of Germany's No. 1 in software protection and the leading edge technology of a US semiconductor company to create the ultimate software protection tool. Hardlock E-Y-E is based on a custom chip featuring secure algorithmic response rather than simple bit swapping or counting schemes.

What software developers like...

Hardlock E-Y-E combines all the features software developers require in a single product: algorithmic response to provide security and an optional non-volatile memory to allow custom configurations. FAST Electronic has made implementation of Hardlock E-Y-E in your software easy. Use HL-Crypt to protect .EXE or .COM files, or incorporate high level language interface routines in your software. The algorithm parameters and the contents of the memory can be programmed in seconds using our Crypto-Programmer card. This unique card guarantees that no one else can burn your original codes. Simply plug the card into any PC slot and start up your own Hardlock E-Y-E workshop.

What your customers will like...

Hardlock E-Y-E allows unlimited backup copies. The device is shipped with the software for the user simply to plug into the parallel interface and forget.

Daisy chainability, outstanding reliability (no battery is needed), and the most compact High-Tech design ensure that your customer will accept Hardlock E-Y-E.

What your accountant will like...

Hardlock E-Y-E needs no factory coding. This ensures optimum delivery schedules and stock flexibility. Revenues will go up as software piracy and multiple usage are prevented. Despite its wealth of features, Hardlock E-Y-E's prices remain competitive.

...As more and more software developers, customers and accountants appreciate the Hardlock E-Y-E device, hackers like it less and less.



Hardlock E-Y-E
programmable, algorithmic response
and memory option – all in one.



Order your demo unit today. Contact Magnifeye,
235-239 Walmer Road, Walmer Studio #6, W11 4EY, Telephone 071 221 8024, Fax 071 792 3449.

method for doing so. We never use the feature ourselves because it only addresses half of a problem. If you password encrypt your files then you had better be certain you have 100% accurate and reliable backups. If you can't guarantee a reliable backup copy of your data and your hard disk suffers from a wordslip, then not only will access to your data be denied to others, you won't be able to access it either! That is not to say the encryption system is unbreakable, especially if you know what the data is supposed to look like, but the encryption method is sophisticated and cracking it is not a trivial matter. The information concerning the structure of the file is not affected by encryption although the data is. If you genuinely believe your information is sensitive enough to justify encryption then it also justifies the cost of a reliable, dedicated backup system to match.

Skinning Cats

Another feature of Paradox files is that you can create secondary key indexes using the {Tools}{Query}{Speedup} function. This creates a pair of index files with extensions (.X01 and .Y01). These indices are also kept in the same file format as the Paradox data files but re-sorted. The techniques outlined

do not attempt to maintain these indexes, although you will be able to access the data file on a read-only basis. Again our experience indicates that there are alternative ways to obtain performance without recourse to indexing files.

Field 17 TrCnt is a transaction count. Every time an item is sold this value is incremented. Every time Paradox is loaded, it looks for a script called 'Init' and executes it. It can be made to accept a password or to sort a file. If in our case, it sorts the file so that items with the highest transaction count are at the beginning of the file, then the items which are needed most frequently will have the shortest access times, furthermore, as demand patterns change the system adjusts. By this means we save the storage space of the two indexes and have the most efficient algorithm available for our purpose. Far from adding to the system requirements this feature gives vital management information. The ten items at the top of the list are the 10 best sellers. The ten at the bottom are candidates to be dropped from the product range. Even that isn't the end of it. Many manufacturers will produce items to order which they don't normally have a demand for.

In this example, stock minima are re-calculated as a moving average of demand over the past six months. It is important that the stock minimum is not increased on the basis of a single large order. So our stock minimum calculation program will be 'moderated' by the number transactions. A single order for say, 2000 items will not alter the stock minimum from 0 whereas 100 orders for 20 will.

Conclusion

Paradox files can be directly manipulated - if your need is great enough.

EXE

Larry Adlard is the managing director of A & A Management Research Ltd. He originally trained as an accountant but switched horses when he decided that programmers, not accountants would rule the earth. He has been involved in the 'Micro business' since 1978. The first machine he programmed had 2KB of memory, a hexadecimal keyboard, a three and a half digit, seven segment LED display, and an audio tape drive interface! History records that it actually worked.

'DESkey' Software Protection system from Data Encryption Systems Limited

We have more experience and expertise in the design of software protection modules (dongles) than any other company in the UK. We

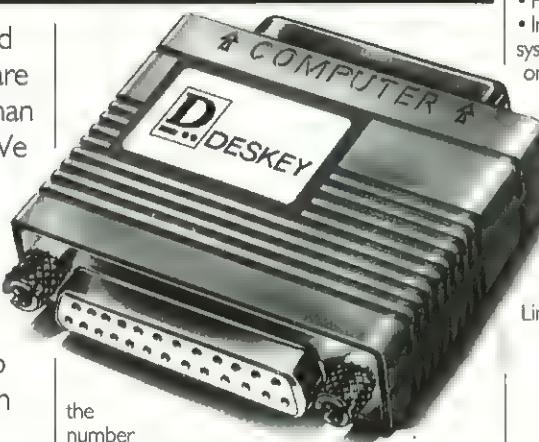
sell only products designed in house by our own engineers - the same engineers that give you technical support. More than 13 years experience in the design of dongles have gone into our current product range with features such as:

- Pseudo Random Number Generator: Billions and billions of random numbers without repeating. Software and Data encryption could not be easier. 'Seedable' too!
- Through Encryption. Data may be fed into the DESkey for on-line encryption. This keeps the encryption key hidden.
- Memory. Up to 240 bytes of memory split into 'Public' and 'Private' sectors. The 'Public' sector may be read from and written to at will. The 'Private' sector may be read at will, but for writing, it requires your customer specific password.
- Down Counter. You program into the DESkey

the number of times the program should run before stopping. This gives you the ability to sell 'goes' of your software rather than an open licence to use it forever - or even to send a fully working demonstration copy that will stop working after say, 10 goes.

• Variable Response Algorithm. This feature is similar to the well known 'public-key' algorithm and works in conjunction with an algorithm on the host computer. Makes any attempt at software emulation impossible.

• Secure Memory Read. Even if the same memory data is read repeatedly, the data returned from the DESkey never appears the same - this also makes



the number of times the program should run before stopping. This gives you the ability to sell 'goes' of your software rather than an open licence to use it forever - or even to send a fully working demonstration copy that will stop working after say, 10 goes.

• Variable Response Algorithm. This feature is similar to the well known 'public-key' algorithm and works in conjunction with an algorithm on the host computer. Makes any attempt at software emulation impossible.

• Secure Memory Read. Even if the same memory data is read repeatedly, the data returned from the DESkey never appears the same - this also makes

the DESkey impossible to emulate.

- DESlock® automatic .EXE or .COM file encryption system. No need for source or .OBJ files. Takes only 5 seconds or less to protect your software.
- Transparent and Cascadable/Stackable. Does not interfere with any other device wanting to use the same port - even allows other manufacturers dongles to work
- Parallel, Serial or Bus versions available.
- Intelligent Serial devices suitable for any operating system such as Unix, Xenix, OS/2, DOS etc. Works on any hardware including PC Networks, Mini Systems or even Mainframes.
- No programming units required and NO hidden extras.
- Free lifetime telephone support direct with the designers.
- Free evaluation Kits.
- Guaranteed Exclusivity to all our customers.
- Fast Order Turn-round.
- Sold only through Data Encryption Systems Limited.



Data Encryption Systems Limited

Edbrook House, Cannington,
Bridgwater, Somerset. TA5 2QE
Telephone (0278) 653456
Fax (0278) 653300

Memory

Some UNIX systems can now take advantage of virtual paging to map files into memory. Peter Collinson has been using the technique to soup up some tired old code.

I have been doing some 'real' programming recently, porting some code that I wrote around five years ago. The code is a cooperating suite of 6 programs, around 25,000 lines of C. Its job is to generate the quarterly invoices and statements for the UK part of Usenet, UKnet. It turned out that it was sensible to rewrite most of the code to adapt to the world now, rather than the world that existed when the programs were originally created.

The exercise has lead me to think a little about how I go about doing things and how that has changed since I started writing programs for UNIX in 1976 or so.

Some background

The accounting programs are not particularly interesting in themselves. I guess that they are 'very UNIX' in the sense that they are designed to read information from many different sources, and these sources are all text files.

A major part of the input data is a set of files called 'the maps' which are used to store information about each individual site on the network.

Each file contains lines of the form: a keyword, a colon, and some data. The map entry for my site begins:

```
Name: hillside
NRS-Name: uk.co.hillside
Organization: Hillside Systems
Contact: Peter Collinson
Phone: +44 227 761824
Fax: +44 227 762554
Postal: 61 Hillside Avenue,
        Canterbury,
        Kent CT2 8HA
Electronic: pc@hillside.co.uk
...
```

By convention, my map entry is stored in a file called *hillside*. This makes it easy for the people maintaining the information to find the relevant file. The programs make no use of the filename, they know that every file contains a record for one site.

Processing the maps

The accounting programs need to read data from these maps. Different programs will need to read different subsets of the data. For example, consider the program that looks in the mail logs to work out who has sent mail and should be charged for the privilege. It needs to know the name of each site that it will charge. Sites also have aliases to their names, the NRS-Name is one of these. The program must pick this aliasing knowledge from the maps. It needs this information randomly, since it is dealing with inbound mail which is completely unordered. On the other hand, it doesn't need to know the name and address of the person who will eventually receive the invoice, only the program that generates the PostScript invoices and statements needs to know that.

If I was implementing this for an early UNIX system, I would have worried about the memory that was available to my program. Life was simpler then and we would have been dealing with many less sites than the present 750 but let's forget that for a minute. If you concatenate all the data for the current set of sites you get a file that is around 87 KB. There's no way that we can read all that information into the limited memory space of our early UNIX system (limited to 32 KB) so we have to adopt different strategies.

The programs would only read the information that was needed for them to operate. The mail charging program would perhaps be able to scan the maps and build up a table of names in memory. The invoice printing program needs a lot of information from each map, but will need it in less random order. It can afford to read the map that it requires for the site that it is processing at the moment.

Both of these programs will read the map files perhaps using the standard I/O library. They will read data from the files a small

piece at a time, storing what is needed for later processing and simply discarding other stuff. The interesting thing about this approach is that it has become a standard, a little *de facto* in places, but a standard never-the-less. It is portable into a great number of different environments, from the weakest PC based system, through UNIX workstations, into small mainframe systems running a variety of operating systems and up to the largest IBM based installations.

Pulling files into memory

When I moved from the memory limited systems onto the systems that supported virtual memory, I began to stop using the 'read pieces into memory' approach. The original accounting package of five years ago was coded using a routine that pulls a complete file into memory:

```
typedef struct {
    char *base;
    int len;
} Fhandle;

Fhandle *
load_mem(fname, fp)
    char *fname;
    Fhandle *fp;
{
    int fd;
    int sz;
    char *rv;
    struct stat statb;

    fd = open(fname, 0);
    if (fd < 0)
        return(NULL);

    fstat(fd, &statb);
    sz = statb.st_size;

    rv = malloc(sz);
    if (rv == NULL)
        sz = 0;
    else
        if (read(fd, rv, sz) != sz) {
            free(rv);
            sz = 0;
        }

    close(fd);
    fp->base = rv;
    fp->len = sz;

    return(sz != 0 ? fp : NULL);
}
```

Special Low Price offer to *.EXE* readers



386DX-33 Computer

(Upgradable to 486DX)

Low Radiation monitor

... and DOS 5.0

... and Windows 3.0

... and Mouse



Features

- Intel 80386DX 33MHz. Provision for a 80387DX co-processor
- 64Kb fast 25nSec SRAM cache
- 2-16 Mb RAM, 0 wait state
- Shadow RAM for the BIOS
- 1.44 Mb and/or 1.2 Mb Disk Drives
- 40 Mb, 100 Mb, 180 Mb Hard Disk
- Two RS232C Serial Ports
- One parallel Centronics printer port
- 102 Key U.K. keyboard
- 16 Bit Super VGA card 1024 x 768, 0.5Mb or 1Mb memory
- Low Radiation, Super VGA colour monitor
- Microsoft DOS 5.0
- Microsoft Windows 3.0
- Three-buttons Serial Mouse
- Copam's one year r.t.b. warranty (on-site maintenance optional)
- Barnett Electronics' (est. 1979) second-to-none after sales service
- 10 Days trial. Money back guaranteed if returned within 10 days



For price and further information please contact:

BARNETT ELECTRONICS LTD

10 Barley Mow Passage, London W4 4PH

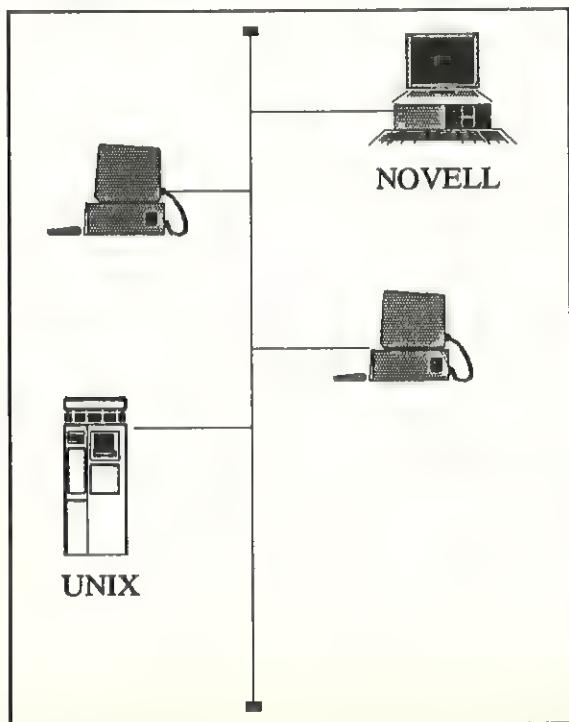
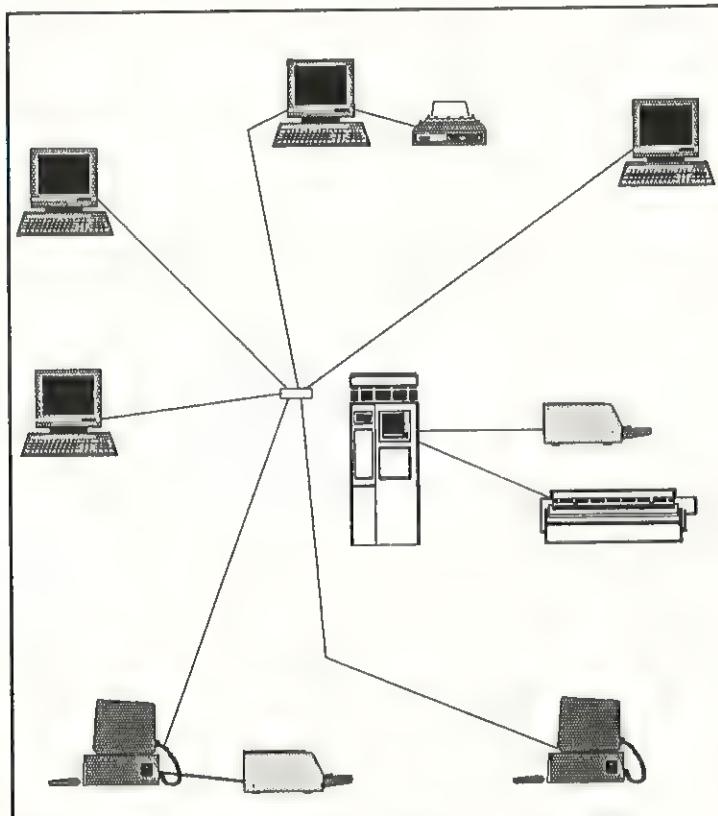
081 995 3715



SMOOTH SKATING BETWEEN DOS AND UNIX/XENIX

*** ICE.TEN ***

- Exact WYSE 60, ANSI, VT220 & VT100 terminal emulations, memory resident in 42K of DOS memory, giving instant switching between DOS and UNIX screens.
- Uses standard RS232 ports/cables
- Support for ANSI colour codes in all emulations.
- Fully programmable function keys
- Transparent and local print to PC's parallel port.
- Easy file transfer between PC and Host with an MSDOS style copy command.
- DOS applications can share UNIX printers.
- From £350 for an UNLIMITED no. of PC's linked to a single host.



*** ICE.TCP ***

- A DOS version of TCP/IP with the same exact terminal emulations as ICE.TEN
- Fast and simple file transfer.
- Can coexist with Novell and other DOS networks
- Drivers for most popular Ethernet cards.
- £195 for 1 PC, £995 for 10 PC's, £2995 for 25 PC's, £4995 for 100 PC's.

Custom Business Systems Ltd
TEL: 071 323 2297
MSDOS to UNIX experts.

Of course, this omits loads of include files and doesn't worry about casts and other bits of current C bag and baggage. It should test for zero length files and worry about the return values of various calls.

The routine opens the file and uses `fstat` to find its size. The `malloc` routine grabs some memory and a single `read` call is used to pull the file into memory. I have wrapped this up using a plausible call mechanism. I guess that I generally will sprinkle the routine itself with failure messages where needed. The actual details of this interface change every time I write this code.

The idea here is that you can get the whole file into memory by calling

```
rv = load_mem("file", &fh);
```

This revolutionises programming. Suddenly, many of the problems associated with reading the file line by line or character by character simply disappear. It always seems much less complicated to look at a bunch of characters in memory and parse them than it is to read them in one at a time doing the same job. I generally write code that zips through the connected file looking for strings and creating a table of structures. Perhaps:

```
struct address {
    char *contact;
    char *organization;
    char *postal;
};
```

These variables will point directly at the memory containing the file. I tend to ensure that the values become zero-byte terminated strings because it makes life easier. This is easy, simply replace the newline character that ended the line in the file by a null byte and off we go. We have to worry a bit about extraneous white space.

The routines that extract the information from the file that has been read into memory are often pretty disgusting with much ad-hoc pointer handling. But they do work quickly, and that is another desired aim.

Again, this technique is reasonably portable if you have enough memory. If you run out of memory to allocate for the file, then you have probably blown it - the program will just fail.

Mapping into memory

The technique of allocating space and pulling files into memory using one read call is reasonably fast. It does mean that the data is copied. At best, it comes from the disk into kernel memory and is moved from there into user space. On machines with demand paging, it should be possible to use the paging system to bring data files into

memory. After all, that is what is happening to the executable bits of programs that are running. This idea was a gleam in the eye of the designers of 4.2BSD in the mid-80's. They specified the system call and how it should operate. Unfortunately, it was never implemented because of deficiencies in their paging system.

In recent times, Sun Microsystems implemented the call and this has found its way into System V, release 4. It's also being defined by the working group looking at real time extensions in POSIX. I expect that the ability to map files into memory will be present in all UNIX systems within a year or so.

Let's rewrite the `load_mem` routine in terms of the memory mapping system call `mmap`.

```
Fhandle *
load_mem(fname, fp)
    char *fname;
    Fhandle *fp;
{
    int fd;
    int sz;
    char *rv;
    struct stat statb;

    fd = open(fname, 0);
    if (fd < 0)
        return (NULL);

    fstat(fd, &statb);
    sz = statb.st_size;

    rv = mmap(0, sz,
              PROT_READ|PROT_WRITE,
              MAP_PRIVATE, fd, 0);

    if ((int)rv == -1)
        sz = 0;

    close(fd);

    fp->base = rv;
    fp->len = sz;

    return (sz != 0 ? fp : NULL);
}
```

Again the code needs some improvements for real use. The first part of the routine is the same, the file is opened and its size obtained. The `mmap` routine is then called. This call returns the base address that has been allocated for the file or -1 on any error.

The `mmap` system call

There are six parameters to the system call. Beware that the information here pertains to Sun's implementation and things might be different on your system.

```
caddr_t mmap(addr, len, prot,
              flags, fd, off)
caddr_t addr;
size_t len;
int prot, flags, fd;
off_t off;
```

The first, `addr`, tells the system where the process would like to have the file mapped into its address space. Most of the time this

is 'don't care' and a zero value says just that. If you wish, you can supply a specific address that acts as a positioning 'hint' to the kernel. The file will be connected at a convenient address near to the hint. If you add `MAP_FIXED` to `flags` then you can force the value of `addr` to be the base address for mapping. This is not recommended since you might adversely affect the way of the system wishes to manage its resources.

The second parameter, `len`, gives the length in bytes that are to be mapped by the call. It doesn't have to be the length of the file. You should think of the map as a 'view' into the file; and views can be altered. If `len` is longer than the file, then the remaining bytes up to the next page boundary are accessible and are zero filled. Your process will be sent a `SIGBUS` signal if you attempt to access above that.

The third parameter `prot` gives the form of protection that will be given to the pages allocated for the file. You can supply read, write and execute protection. In the case above, you might think that we only want to read the file and should say `PROT_READ`. You will recall that we want to stuff null bytes into the data, so we want to write to the pages. We will also use `PROT_WRITE` to say that we are going to write to the memory that maps into the file.

The `flags` parameter provides other information about handling the mapped pages. A subfield of the `flags` parameter indicates options that are applied when pages are altered by the program. Sun gives you two options. `MAP_PRIVATE` indicates that a change to the page is to be retained by the process. By setting this in the example, we ensure that our null bytes don't find their way out onto the file, the pages stay private. `MAP_SHARED` says that a change to the page will be reflected in the actual stored file and also in the data that any other process reads for the file. `MAP_FIXED` can be ORed into the parameter.

The `fd` parameter is the file descriptor of the open file. The `off` parameter is a file offset, this allows you to change the view on the file, mapping the file into memory starting from this offset.

Mapping actions

Nothing visible happens when the file is mapped into memory. Actually the page tables for the process will be altered to point at the particular file, but the file will not be read. The page table entries will say that the data is paged out to disk. As soon as the process accesses the data in the mem-

ory, the hardware will force a page fault and the full panoply of the memory management system will be brought to bear on the problem. The disk will be accessed, the page read into memory, the page tables fixed up and the process restarted.

None of this is apparent to the process, it sleeps until its data is available. If the process doesn't touch a page in the file then the data is not read. This can be a win if you only need to look at parts of the file.

Moving data into the pages constitutes a write operation to the file. We have seen that you must enable writing by supplying `PROT_WRITE` in the `prot` parameter. If the `flags` parameter contains `MAP_PRIVATE` then a change that has been made to the page is private to the current process. To achieve this, the original page is copied in memory and the page table entry for the process is set to point at the new page.

If the `flags` parameter contains `MAP_SHARED` then the change that is made to the page of the file will find its way onto disk. The contents of the page may be pointed to by several processes and all these processes will see the new page contents.

Unmapping a file is simple, you just call `munmap()`. The call releases any memory resources that are used by the mapping. To unmap the file, all we need is the base address and a length. The system call to do this looks like:

```
int munmap(addr, len)
caddr_t addr;
int len;
```

The `addr` parameter is the value returned from the `mmap` call. The `len` parameter is the length in bytes that you wish to unmap.

It is important to notice that unmapping is independent of the `close` system call. We cannot map a zero length file into memory, plonk 200 bytes of data in the buffer and then unmap the new 200 bytes 'back' onto the disk. You have to extend the file somehow. The system call that changes the length of a file is `truncate`. A call to this or `ftruncate` will set the file to the new length.

Using `mmap` to create a random length file is a pain. First you must create the file using the `creat` system call. This will make a zero length file. Next we use the `truncate` call to make the file some 'maximum' size. Now we map this 'maximum' size into memory using `mmap` and add the data into the memory that has been mapped. Let's

say we add 3000 bytes. We must now call `truncate` again using 3000 bytes as a parameter to set the file size. Finally, we can `unmap` the file. Yuck, it's easier to use the standard I/O library.

I am happy to use the `mmap` call only in circumstances where it seems to work well and naturally. I rewrote the accounting code to connect files into memory for processing, and I think this has resulted in a notable speed increase. I do the same for processing the log files which are each around 3 MB. These are mapped into memory, scanned once and unmapped. The performance is good.

Is all this portable? Well, you should be a little circumspect. It's true that not all UNIX systems support virtual memory. It's true that not all UNIX systems supply you with a `mmap` call at present. It should be coming though.

EXE

Peter Collinson is a freelance consultant specialising in UNIX. He can be reached electronically as pc@hillside.co.uk (although your mailer might be happier to put the address the other way round) or by phone on 0227 761824.

Buy EZWIN32® or NDP-GKS® from Microway and we will give you an NDP C, C++, Fortran or Pascal Compiler absolutely FREE OF CHARGE!

EZWIN32 provides the first multi-language support for the Windows 3.0 platform. Microway's globally optimising, protected mode NDP-386 Compilers can now take advantage of the Windows 3.0 environment.

Programmers can run 32-bit applications

which utilise the four gigabyte flat memory model of the 386 running in Windows 386 enhanced mode.

EZWIN32 is priced at £395.

NDP-GKS is a library of computer graphics functions that are portable across a large number of computers and graphics

devices. NDP-GKS provides facilities to draw and manipulate primitives, perform raster operations, interact with an operator, transfer images to other computers, plus many other functions. It is designed to be used in conjunction with Microway's NDP Fortran and C compilers for i386, i486 and i860 processors and is available for both DOS and UNIX.

NDP-GKS is priced from £775 for the DOS version.

To find out more about Microway's 386,

486 and 860 compilers and this offer call our Technical Sales Department at:-

Microway (Europe) Ltd., 32 High St,
Kingston upon Thames KT1 1HL
Tel: 081-541 5466
Fax: 081-546 0614 or
dial 100 and ask the operator
for FREEFONE MICROWAY.

NDP FREE!



CIRCLE NO. 593

MKS RCS

When a change . . .

INCLUDES

FREE MKS MAKE



. . . isn't as good as the rest

Nobody gets it right first time.

Sometimes you do, but then throw it all away by making so many of those "subtle" little changes, you end up stuck with something that looks nothing at all like how you wanted it to.

Still, that's life. Or at least that's life before MKS RCS - the Revision Control System that keeps a complete history of all the changes made to your files. It lets you retrieve any, or all, of them without any fuss. You can retrieve them

by date, by release number, or by whatever name you had previously given them.

Binary or text files? They're handled by MKS RCS with the same contemptuous ease.

Multi-users? No problem. A locking feature prevents more than one person from ringing the changes at any given time.

Branching? You can have as many parallel branches as you like, meaning you really will be able to see the wood for the trees.

Other features? File-compression; a new menu interface; conversion facility from SCCS files; compatible with UNIX system RCS.

Change away to your heart's content. If you *did* get it right first time (or the second, or the third, or the fourth...), you can go back to it at any time you like.

But there's one change you'll want to make permanent. And that's the change to MKS RCS. Call 0763 244144 for details.

Compatibility: MKS RCS is available for DOS, OS/2, XENIX and 386/UNIX.

For an MKS brochure contact the sole UK distributor:

The Software Construction Company Ltd, 1 The Maltings, Green Drift, Royston, Hertfordshire SG8 5DB. Telephone: 0763 244114. Fax 0763 244025

MKS RCS, leader in performance AND price: DOS version £165 (5-user licence £645); OS/2 version £225; DOS & OS/2 version £259.



Books

C++ for macho programmers and OS/2 for, well, anybody who's interested...

No laughing matter

Advanced C++ Programming Styles and Idioms. Be warned: do not disregard the title of this book! It does indeed cover some advanced C++ concepts. Even if you are a strong C programmer who is only just beginning to look at C++, you'll want something different.

If, however, you've already learned the semantics and syntax of C++, you'll almost certainly have come across the problems which this book addresses. From an impressive collection of 'names' at AT&T Bell Laboratories, James Coplien has gleaned a series of C++ programming idioms which can benefit us all. These are presented in a clear way, and are followed by guide-lines on when to use them, and the reasons for doing things that way.

The book starts with topics such as data abstraction and inheritance, running through to reuse and dynamic multiple inheritance. Each idiom is discussed in depth, with plenty of useful code examples, and some rather testing problems if you are feeling masochistic (the appendix with the solutions was sadly omitted).

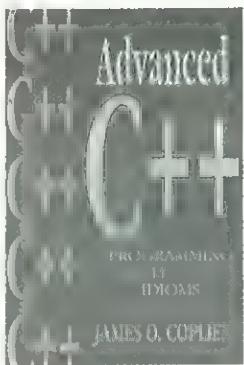
So far, so good. In common with many good works, this has some minor (and some not so minor) irritations. The overall presentation is quirky and haphazard. The appendices seem to contain a miscellany of items for which the author could find no other place (but I could). Some are just long code listings, but others cover important topics such as 'Why bitwise copy doesn't work' and 'Reference return values from operators'.

The writing style is quite dry: full of wisdom, but no wit. I don't think the author understands humour, or more relevantly, its importance in striking a rapport with the reader. Worse than this, some of the phraseology is a real block to communication.

Gripes apart, this is an important and useful book. Bjarne Stroustrup gave us a powerful weapon in C++. As he says, C++ may make it more difficult to shoot yourself in the foot, but if you do shoot yourself, you'll blow your leg away. Any well conceived guidance in using such a weapon is surely welcome, but in this case, don't expect it to be fun.

Review by Dr Gareth Blower

Title: Advanced C++ Programming Styles and Idioms **Price:** £27.85
Author: James O. Coplien **Publisher:** Addison Wesley
Pages: 520 **ISBN:** 0-201-548-550



A Recipe for OS/2

The Design of OS/2 by Deitel and Kogan is a slightly misleading title for a book which aims to give an overview of both the 16 and the 32-bit versions of OS/2 (ie OS/2 V1.x and V2.x). They are almost like two different operating systems.

The first part of the book is dedicated to giving the reader an insight into the evolution of the operating system, providing background information on some of the external forces that moulded OS/2. Beginning with the birth of the PC, the authors tell the familiar tale of how IBM asked Microsoft to write the DOS operating system for the new IBM baby. This is followed by a look at the PC hardware. Perhaps the most relevant chapter in the earlier part of the book is the one in which Deitel and Kogan provide a detailed description on how OS/2 was designed to take advantage of memory management on the 286/386.

After the history lesson, *The Design of OS/2* turns its attention towards the architecture of OS/2, covering multi-tasking, memory management and inter-process communication (IPC) on both the 16 and the 32-bit versions of the operating system. The authors look at how processes and threads are controlled under OS/2 and they provide a good argument for the use of multi-threading over a single-threaded operating system. Virtual memory management is examined, but the authors have provided too much detail, making it far more difficult for a casual reader to grasp these concepts. Much of this information belongs in a reference manual. Again, both the 16 and 32-bit APIs are introduced, covering segmented and paged memory management.

Other features of the architecture such as I/O management and Presentation Manager (PM) are also given. I/O management looks at the advantages of the High Performance File System (HPFS) over DOS's FAT and outlines the DEVHELP services.

The Design of OS/2 describes the architectural features of both OS/2 V1.x and OS/2 V2.0. Throughout the book, the authors have described the advantages of OS/2 V2.0 but there is no summary table that lists these. It doesn't cover the API in depth but the material that it does present helps to reinforce the theory. My impression is that, if you want to learn more about the OS/2 architecture, *The Design of OS/2* is worth considering.

Title: The Design of OS/2 **Price:** £32.25
Author: H M Deitel and M S Kogan **Publisher:** Addison Wesley
Pages: 389 **ISBN:** 0-201-54889-5

Books Received This Month

PC Interrupts by R Brown & J Kyle
Open System LANS by J Houldsworth
Signal Processing in C by C Reid & T Passin

| | | | |
|-----------------------|--------|---------------------|--------|
| Addison Wesley | £27.95 | ISBN: 0-201-57797-6 | pp1023 |
| Butterworth-Heinemann | £25.99 | ISBN: 0-7506-1045-X | pp400 |
| Wiley | £33.95 | ISBN: 0-471-52713-0 | pp323 |

Graphical User Interface CLEARING HOUSE

"Europe's Largest Distributor" for Microsoft graphical environments

* the Premier reseller of Windows applications
* offering the most complete selection of products

* with new products added weekly
* and the best service available anywhere

Thousands of Windows and OS/2 Applications to Choose From

File Edit Search Order!

General/Utilities

| | |
|------------------------|-----|
| File F/X | 38 |
| Intermission | 32 |
| More Windows | 61 |
| PackRat 4.0 | 169 |
| PLUS for Windows | 112 |
| PubTech File Organizer | 61 |
| SmarText (Lotus) | 244 |
| Whiskers Pro | 24 |

Publishing/Graphics

| | |
|-------------------------------|------|
| Adonis Clip-Art Window Shop | 34 |
| Aldus PageMaker 4.0 | 324 |
| Ami Professional 2.0 | 187 |
| Archetype DESIGNER | 464 |
| Corel DRAW! 2.0 | 232 |
| Describe 3.0 | 260 |
| Fullshot (InBit) | 47 |
| HuJaak (Inset Systems) | 83 |
| Image-In-Color | call |
| Image Prep 4.0 | 147 |
| Instant ORGCharting | 89 |
| Micrografx Charisma | 209 |
| Microsoft Office for Windows | 295 |
| PowerPoint for Windows | 192 |
| Publishers PaintBrush | 198 |
| WordScan Plus | 409 |
| Word for Windows | 192 |
| Excel for Windows (Microsoft) | 192 |
| Lotus 123 for Windows | 261 |

Connectivity

| | |
|---------------------------|------|
| DaVinci eMAIL for Windows | call |
| DyniComm (Sync or Async) | 158 |

MULTIMEDIA, etc.

| | |
|-----------------------------|------|
| Action! | 238 |
| Animation Works Interactive | 203 |
| Erasable Optical Drives | call |
| Glide 3 (Owl Int'l) | 286 |
| IconAuthor (AimTech) | call |
| MultiMedia Resource Kit | 152 |
| MultiMedia SDK | 230 |
| MultiMedia Toolbook | 323 |
| Multi-Media Works | 91 |
| SoundBlaster | 95 |
| SoundBlaster Pro | 153 |

Database/Forms

| | |
|-----------------------------|-----|
| Superbase 4 ver 1.3 | 261 |
| Chart Builder for Superbase | 107 |

Development Tools

| | |
|-----------------------------|-----|
| Borland C++ | 198 |
| Borland ObjectVISION | 67 |
| Borland Turbo Pascal | 124 |
| C-TRIEVE/Windows | 209 |
| C++Views | 278 |
| Liana Personal Developer | 91 |
| Knowledge Pro Windows | 255 |
| Symantec C++ Windows/DOS | 242 |
| Zortech C++ Dev Edition 3.0 | 295 |
| WindowsMAKER Pro | 578 |

Dynamic Link Libraries

| | |
|----------------------------|-----|
| Graphics Server SDK | 284 |
| Halo Image File Format Lib | 165 |
| Q+E Database Library | 187 |
| ToolBox (Drover) | 152 |

Call For a Complete List of DLL's!

PhotoFinish (by ZSoft)



PhotoFinish combines impressive painting & powerful retouching capabilities into one easy-to-use Windows image processing program. Turn scanned photos into professional-quality images. Supports stitching & de-skewing for hand scanners. Print life-size posters or import images into your favorite Windows applications to make perfect slides, newsletters, brochures and more.

Your cost £84.00

Q+E Database Library (QELIB)

Pioneer



QELIB provides developers with database DLLs and a common, SQL-standard API simultaneously supporting DB2, Oracle, dBASE, SQL Server, Btrieve, Ingres, Sybase, Network SQL, Paradox, SQL Base, OS/2 ESDDBM, XDB, Excel & ASCII. Use any tool that can call a DLL -- including Visual Basic, Realizer, ToolBook, C, C++, Actor, Word, Excel, etc. Distribution agreements available.

Your cost £187.95

GUI-EURO's NEWS Flash

PictureBox For Windows (by Highland Grafix)



PictureBox is a MultiMedia Authoring & Presentation application with the scope to meet your most demanding needs. At a price accessible to all, PictureBox is designed to make developing in-house MultiMedia presentations easy and quick. Supports live video, user DLL's Meta files, stills, sound, graphics and text. No programming required.

Your cost £149.00

WinImage Image Toolkit (by Highland Grafix)



WinImage is an easy to use, customizable, developers imaging DLL. Complete w/full documentation and is Royalty Free! Supports all Windows compilers. Image support includes TIFF, PCX, EPS, Bitmaps, GIF, Metafiles, numerous special effects F/X, animation and much more.

Your cost £199.00 Including Source £995.00

NEWS Flash GUI-EURO SUPPORTS YOU!

GUI is the first European reseller specializing exclusively in products for Microsoft Windows

Meet Our Sales Team - they offer thousands of products for Microsoft Windows graphical environments, at very competitive prices. Our professional sales staff are backed by a team of experienced technical consultants that answer in-depth technical questions on products and assist customers in product selection.

Our Sales Team will Not Be Beat!

Software Research Services - For customers having difficulty locating a particular application or business solution, GUI's Technical Consultants will search out software that meets the customers' requirements.

Technical Consultants - The technical support staff at GUI has an average of ten years experience in the use and development of graphical user interface products. The diverse backgrounds of the technical staff include training, multimedia productions, support and development of software and hardware. The Technical Consultants are responsible for searching out and evaluating new products in both environments.



FAX: (03552) 64777
North America: (203) 268-4400
03552-64888
Monday - Friday, 9 am to 8 pm

CIRCLE NO. 595

Joining in the Standard

Francis Glassborow, our intrepid C User, spends a day on the Standards panels.

I spent yesterday, 4th February, representing CUG(UK) on two panels of IST; /5/14 - C Panel and /5/21 - C++ Panel. This was the result of our discovery that both panels would welcome contributions from ordinary users. An unusually sensible view for committees sitting on Mount Sinai.

The morning belonged to the C Panel. A standard (ISO 9899) already exists, but one of the conditions for the UK withdrawing its 'no' vote (three no votes at ISO spell failure as a consensus is the objective) was that there would be an addendum refining and clarifying some parts of the Standard. This addendum is rapidly approaching its final stages (two years is fast at this level). Two other countries have complicated the issue asking to make their own contributions to the addendum.

The Japanese have a substantial proposal on multibyte library functions. Even at this late stage a lot of fluidity remains in this proposal. I gather that the underlying principles are acceptable, but getting the details right is taking time. Remember that whatever is finally agreed will need to last at least a decade.

A proposal from, I think, Denmark is much more controversial. They still have many pro-

grammers using ISO 646:1983 standard terminals. These lack a number of characters that C programmers expect to use (eg # and {}). The trigraph alternatives (??= and ??<) are clumsy and just about unreadable. They want to add other alternatives. These could, theoretically, threaten existing code. The UK vote is in the balance and a 'no' might be critical as a couple of other countries are unhappy with the proposals.

The addendum was by no means the sole business for the meeting and we finally went off to lunch half an hour late, leaving the convener of the C++ Panel getting organised for the afternoon.

Three of the six C Panel members returned after a quick snack at a local hostelry to join the C++ Panel. This meant that 12 of the 14 Panel members were there. The afternoon meeting was in stark contrast to the morning one. This panel is still coming up to speed. The working paper for the Draft Proposed Standard is still slim but much has to be done in getting to grips with the implications before progressively refining the material to an acceptable and viable standard. The excellent work done on the C Standard will help make this task easier. I noticed an

impressive depth of experience of writing standards among the panel members.

The main business of the meeting was looking forward to the next meeting of ISO/IEC JTC1/SC22/WG21 and X3J16 (the ISO and ANSI committees working on a C++ standard). This meeting will be held in London, 16th-20th March.

Unlike the C Panel, the C++ Panel adjourned early, but we have plenty of homework and much of it has to be done in the next few weeks.

The final point I would like to make here is that the entire infrastructure (including travel to overseas meetings) for the development and maintenance of standards for computing languages is run from a budget that is less than the earnings of a single consultant.

You will find more details of both the C and C++ panel meetings in the current issue of CVu, the journal of CUG(UK). You will also find details of how to make your contribution in the same place.

EXE

For information about CUG(UK) write to 64 Southfield Road, Oxford, OX4 1PA or ring 0865 246490.

BOSTON SYSTEMS OFFICE/TASKING 16 Fernhill Road, Farnborough, Hants GU14 9RX, England

REAL ENGINEERS WOULDN'T GIVE A XXXX FOR ANY OTHER REAL TIME EXECUTIVE

If you want a fully pre-emptive real time executive with fast context switch time, dense code size and fast primitive execution time you need BSO/Tasking's Real Time Craft.

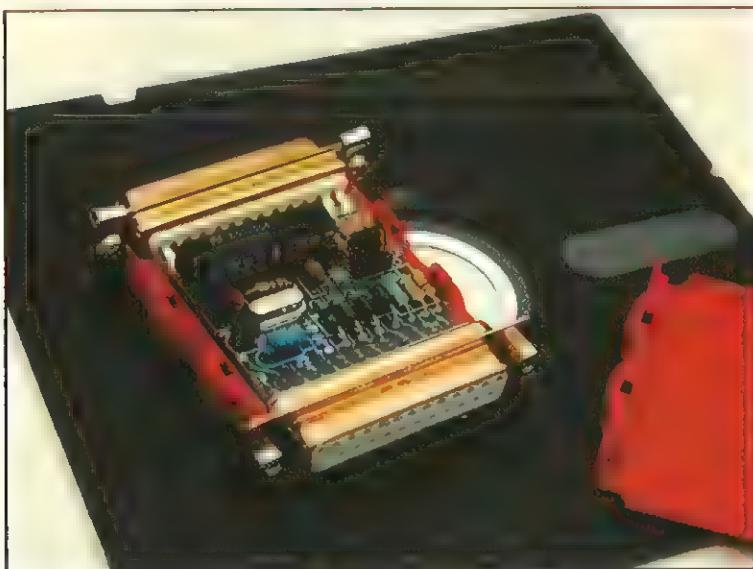
If you are programming the 80XX6 series, the 68XXX series, the AMD29000 or other 16/32 bit devices and you are programming in C, Pascal, Fortran or Assembler you need BSO/Tasking's Real Time Craft.

If you want a product that comes with one years free technical support from a worldwide manufacturer of software tools you need BSO/Tasking's Real Time Craft.

For a FREE information pack contact 0252-510014 or write to the address at the top of this advertisement. Alternatively write in number 60 on the reply card.

Real Time Craft. THE Real Time Executive

Announcing DeadLock III



Don't think Dongle, Think DeadLock

- Unbreakable
- Price unbeatable
- Completely new system
- Approved as the highest security available

Technical

- ★ Sits on parallel port
- ★ Completely non-intrusive and transparent
- ★ Programmable
- ★ The hardware component is based on a custom-designed IC
- ★ There's full **DeadLock** support for today's most popular languages, compilers and development environments
- ★ **DeadLock** contains all the logic necessary for password control and to perform calculations
- ★ **DeadLock** comes with a special PROTECT utility that allows you to build an 'envelope' of protection around your product's COM or EXE files
- ★ Each **DeadLock** key can be programmed by you, to transform it into a protection device that's unique to your product
- ★ Easy to use manual
- ★ May be used for joint ventures
- ★ **DeadLock** comes with a variety of friendly, menu driven utilities
- ★ Different coloured cases available to suit your preference

Please address all enquiries to:

BL Computer Security Limited
101 Hendon Lane, Finchley, London N3 3SH
DeadLock
PO Box 2543, London N3 3UA, United Kingdom
Fax: 081 346 2672 Tel: 081 343 0734 Northern Ireland Tel: 0232 682047



Why the ECUG?

'What, another User Group?' Mike Banahan justifies the European C++ User Group's existence.

Why bother to start a User Group for C++? Mainly because I felt it was nothing like as cut-and-dried as a lot of the other technologies are. C++ has a feel about it which is very much like the early development of UNIX (in the late '70s). They were heady days - people would meet to swap war stories, exchange source code, discuss hints and kinks - and most important of all, get merrily plastered together at technical conferences. Just ask Peter Collinson (you can have the negatives for a fee, Pete).

C++ is at a very similar stage of its evolution. It is clear that it is going to have a substantial effect on the way that people work, even though none of us is sure just what. It's resemblance to C is only that - a resemblance - and the more you learn about it, the more you realise just how different it really is. The tricks and techniques take a long time to learn; people who can reach expert level in simpler lan-

guages like C or Pascal within months will tell you that 18 months with C++ leaves you feeling like 2 months into C. Yet everyone agrees that it's worth the effort!

Given all of that, a user group was clearly called for. Our plan is to provide a forum for discussion and conferences, where experience can be spread and ideas tried out on one's peers. The newsletter is already in place and a source-code library is currently being established. We've had a highly successful technical conference in London at the beginning of December, with the next one planned in Munich in the Summer. Already the fragmentary C++ community has something to help to bring it together and we look forward to several exciting years of development before C++ too slumps into the dreary mainstream of commercial programming.

Who is it run by? At the moment an *ad hoc* committee brought together to get it off

the ground, comprising a mix of users, academics and vendors of products or services. Once it is properly under way we'll be electing the committee from the membership. It's a not-for-profit organisation, owned by its members. At the moment its main focus is on 'serious' users; almost inevitably this means computing professionals rather than hobbyists, but there is certainly no intention to rule out any of the constituency.

See you in Munich: if you can't get plastered there, you might as well give up altogether ...

EXE

Mike Banahan is Chairman of ECUG. Subscription to ECUG is £50 per annum. For more information about its activities, contact Rebecca Thomas on 071 253 5121, or write to ECUG, c/o City House, 190 City Road, London EC1V 2QH.

MARCH .EXEWORLD



ACROSS

- 1&3 What our life is all about (4,10)
- 4 Keep an eye on the screen (7)
- 11 Embossed work in Italy may provide release (7)
- 12 Rather cheeky scheduling software (4)
- 13 The one i/c tapes and discs (9)
- 15 Disorder growing throughout the Universe (7)
- 30 Ring with ASCII 7 (4)

- 18 Trial crucial for new program (4)
- 21 Old TV films showing what the program does in a loop (7)
- 24 Set of steps leading to a solution... (9)
- 25 ...but the program that results may be cryptic (4)
- 27 In other words, train laziness to keep things going (7)
- 28 Build the image again (7)
- 29 Showing initiative is your business (10)
- 30 "Do it yesterday" in short in CIA's application (4)

DOWN

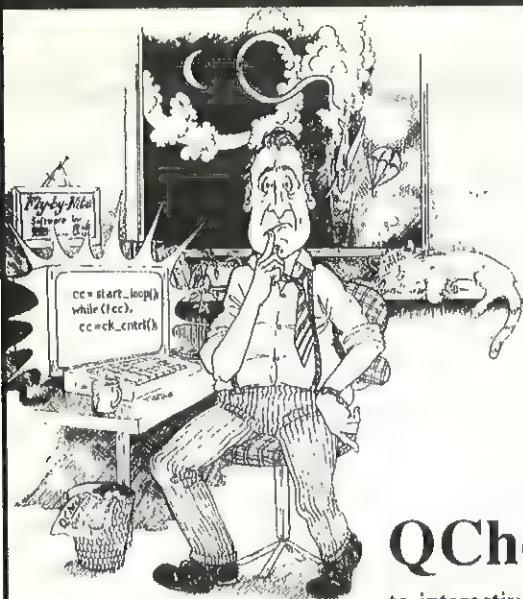
- 1 Filing program initially designed by many students (4)
- 2 Brown fellow puts a graphic line on screen (7)
- 4 In the country with the first robots, pal (7)
- 5 Hound with power bug that can be fixed (7)
- 6 Peaceful greeting in the east (6)
- 7 List the units of data (7)
- 8 Unearthed something irrational? (10)
- 9 Part of network used for training maybe (7)
- 14 Distribute? Quite the opposite (10)
- 17 State your requirements clearly (7)
- 19 Chunk of orange store (7)
- 20 No festival seems biased (3,4)
- 21 Asides kept quiet in 25 (7)
- 22 Where to find the data you want (7)
- 23 Person needing word processor with all the features (6)
- 28 IC from the old block? (4)



'EXEWORLD' compiled by Eric Deeson

FEBRUARY .EXEWORLD

THE SOFTWARE TESTING NIGHTMARE ?



- Are you serious about the way you develop programs?
(Of course I am)
- Do you test your programs?
(Doesn't everybody?)
- How much do you test your programs?
(I try out all, well most, of its functions)
- Do you look forward to testing your programs?
(Who does?)
- Can you quantify how much you test your programs?
(How could I, even if I wanted to?)
- Have you considered the implications of not being able to demonstrate that you have fully tested your program?
(...Ah, um...not really yet)

QCheck is a unique program that enables professional software developers

to interactively find out how much their program has been exercised. It also provides objective evidence in the form of listings showing unexecuted lines. For DOS high level language compilers. A single user licence is £150.00+VAT (how much does just one undetected bug cost you?)

Also - **ETP** an Epson® to Postscript® translation utility that allows existing applications to print to your Postscript laser printer, whether connected locally or on your network. A single user licence costs £55.00 + VAT.

Telephone 0883-341697, Fax 0883-341343

Seltek Ltd., Seltek House, 38 Westway, CATERHAM, Surrey. CR3 5TP.

SELTEK

CIRCLE NO. 606

CLIPPER ADD-ON SOFTWARE

QBS Software Limited specialise in providing the best add-on libraries and utilities for Clipper. We distribute throughout Europe, providing local support centres in France, Germany, Italy and elsewhere through our agents.

| | | | |
|------------------|--------------------------------------|-------------------|---|
| Flexfile | Variable length fields | Scripton | Postscript Library |
| Fast Text Search | Advanced Text Search Technology | Overlay() | Memory Roll Out Utility |
| Dr Switch | Create RAM resident applications | Expert help | The drop-in replacement for Norton Guides |
| FUNCky | General Function Library | CL Text | Word Processing for Clipper |
| Blinker | Dynamic Overlay Linker | SilverClip | Professional Clipper Communications library |
| Netlib | Networking Library | GrumpFish Library | Friendly Function Library |
| SilverComm | Communications Library | GrumpFish Menu | Comprehensive Menu System |
| GFORCE | Fast graphical interface for Clipper | BabelFish | Paradox database driver for Clipper |
| Silverpaint | Graphics Library | ED | The Programmer's Editor |
| SubNtx() | Filtering Utility | Peglib | Linkable Pegasus read/post library |
| SpellCode | Spell Checker | R&R | Relational Report Writer |
| The Engine | Linkable Spell Checker | ClipWKS | Read/Write Lotus/Quattro Pro |
| Biton | Oracle Library | ZipitUp | Software Protection System |

All trademarks recognised.

90 days technical support by phone or fax provided on all systems

For further information, free demo software, prices and how to order please contact:

QBS Software Limited, 10 Barley Mow Passage, London W4 4PH
Tel: 081-994 4842 Fax: 081-994 3441 BBS: 081-747 1979

CIRCLE NO. 562

SIFIED...CLASSIFIED...CLASSIFIED...CLASS

To advertise in this section, please call Marc Warren on 081-994 6477. Fax 081-994 1533

Give **Real-Time** Projects a Head Start with the AMX™ low-cost high performance Multitasking Kernel

Features

Fast, reliable operation
Compact and ROMable
PC Peripheral support
DOS file access
C and Assembler supported
Preemptive task scheduler
Time slicing available
Configuration Builder
Inter-task messages
Message exchanges
Dynamic operations:
- create/delete tasks, timers
- adjust task priorities
- memory allocation
Buffer Manager Event Manager
Semaphore Manager List Manager
Breakpoint Manager
Sample and Demo Programs
InSight™ Debug Tool for use with most popular debuggers

Targets

AMX 86 for real mode 80x86
AMX 386 for protected 80386
AMX 68000 for 680x0
AMX 80 for Z80, 64180 and 8085

No royalties

Source code included

For more information and a free demo disk contact:

ScotWare Ltd

45 Frederick Street
EDINBURGH
EH2 1EP

Tel: 031-225 4858
Fax: 031-220 3550

Real-time and database software specialists

brainy
SYSTEMS (UK) LTD

Motherboards

| | |
|----------------------|------|
| 386SX25 £130 w/cache | £150 |
| 386DX33 128K Cache | £265 |
| 486DX33 256K Cache | £495 |

EXE CLASSIFIED LAUNCH OFFER

80486-33 256KB Cache Mini Twr
4MB RAM - 3.5" + 5.25" Floppy
120 MB Hard Disk
2 Serial 1 Parallel 1 Game Ports
Trident 512 KB VGA Card (1MB option)
UK Keyboard (102 Key)
£1299 exc VAT and Delivery

Call Keith Hickson
Tel: 071 734 5783
Fax: 071 734 7256

PLOT THE DIFFERENCE

PLOTVIEW

In the simple, low cost alternative to paper plots, Able to view and magnify any part of the plot, zooming in on detail.

PLOTVIEW

Has built in 25 standard and user definable plot styles, zooms in on detail and a zoom factor which allows any part of the plot to be magnified in detail.

PLOTVIEW is the versatile tool that can really make a difference to your productivity.

CAMEL SERVICES LTD.

Telephone OXFORD (0865) 512678

The Secret of Successful Advertising Is.....

CLASSIFIED

To find out how you can reach 17,000 professional developers for as little as £85, call Marc Warren on 081 994 6477

windows SHAREWARE



ikonWORKS

22 Hope Street
Leicester
LE1 3BG
0524 39283

KIBWORTH COMPUTER TRAINING

Save time by learning

C or C++

with customised tuition in an ideal environment.

Phone or write for details:

**68 Springfield Crescent
Kibworth Beauchamp,
Leicester LE8 0LH**

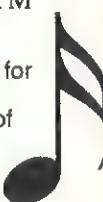
Tel: 0533-792653

Computer
MUSIC Systems Ltd

5-7 Buck Street,
London NW1 8Nj.
071-482 5224

Voyetra Sound Factory™

Sound Factory™ is a complete audio development kit for DOS or Windows 3, from Voyetra, the leaders in IBM music software. Containing drivers for a wide range of sound cards, digital audio boards & MIDI interfaces, Sound Factory™ gives developers as wide a market as possible. Call or fax us for further details.



We also stock a wide range of PC software and peripherals.
Specialists in Music Software

BUGS WANTED!



A new BASIC User Group is looking for volunteer regional co-ordinators to help arrange regular meetings around the country.

If you have an interest or any experience with BASIC programming, please write to:

**BUG
30 Osprey Close,
West Drayton, Middx UB7 7JE**

The Babelfish Paradox Data Driver for Clipper Summer '87 and 5.0x versions.



Call Now for a free Demo Disk.

QBS Software Ltd
10 Barley Mow Passage, London W4 4PH
Tel: 081 994 4842
Fax: 081 994 3441

HIRE INFORMATION TECHNOLOGY PLC

HIRE

GUARANTEED VIRUS FREE

Hire I.T. is the ONLY PC Rental company that can Guarantee all systems are delivered Virus Free and stay that way throughout the hire, because Hire I.T. is the only PC rental company to load Anti-Virus software on every system we ship.

FOR COMPLETE PROTECTION FROM VIRUSES ONLY RENT FROM HIRE I.T.

071 490 1515

OLIVER HOUSE
51/53 CITY ROAD
LONDON EC1Y 2AD

PC Data Security Guide

Data Protection and Security for Personal Computers is a guide for support staff and managers. Everything you need to know about:

- Keeping viruses out of your company.
- Drafting and implementing a corporate data security policy.
- Persuading staff to take regular backups that are known to be reliable.
- Detecting and eradicating software piracy.

Includes comprehensive product guide and lots of trouble-shooting advice.

The price of £145 includes 90 days' free telephone support from the author.

Please call TTK Technical Publications on 081 995 9845 for details and a free brochure.

CLASSIFIED...CLASSIFIED...CLASSIFIED...CLASS

To advertise in this section, please call Marc Warren on 081-994 6477. Fax 081-994 1533

AUTOROUTE PLUS

Telephone Version

Simply dial 0839 300100
and use AUTOROUTE !

- Listen to the Service Information
- Use Telephone Key Pad to Select options
- Enter Location Codes from sample list

Aberdeen 00014 Glasgow 02197 Plymouth 01483
Birmingham 00068 Leeds 03192 Reading 0117
Cardiff 01222 London 01042 Southampton 05357
Edinburgh 01344 Manchester 03367 West End 00952

To obtain a FREE TeleConnection INFORMATION CARD & CODE DIRECTORY
Phone 0839 300102 and leave your address details.

Call charges of 5p per minute of air time and 10p per minute of on-net time.

Tele Connection

Tele Connection Ltd, 2nd Floor, 12, Princes Street, GLASGOW G2 2LS

R&R Relational Report Writer

Database reports made easy
for dBase, Clipper and
compatibles. Also for Paradox,
123s and Quattro Pro.

Turn raw data into useful
information using Lotus like
commands and menus.

Available from

QBS Software Ltd

10 Barley Mow Passage

London W4 4PH

Tel: 081 994 4842

Fax: 081 994 3441

Call for free demo disk

Fonts & PostScript

PostScript Interpreters: from £4 to £4,000
Fountain, GoScript, Freedom of Press,
Ultrascript, PS Tutor, LincPage, NTG2000

PostScript LaserJet Upgrades from £239: Adobe,

HP, Pacific Page, UDF, TurboScript - HP/Canon

PostScript Utilities: ATM, PSFx, PSPlot, Books

Type 1 Fonts from £3 to £3,000: Public Domain,

Adobe, ZSoft, Digi-Duit, Walland Orb

HP Bitmap Fonts: ZSoft, Typografica, Digi-Duit,

Atech, DTS, Walland Orb, Tailor Made

Laser Printer Memory Upgrades: HP, Canon, IBM

Custom Fonts & Logos: most formats available

Custom HP Font Cartridges: from £90 (10 off)

Orchid '486 & Video

Motherboard + Fahrenheit 1280: runs up to
18 times faster than standard VGA: £980

Complete systems from £2469 with NEC 4FG

David Pollard Associates

Folly Bridge Workshops, Thames Street,
Oxford OX1 1SU 0865 240048 Fax 792277

SABREBANNER

For

Helios

Workstation Memory

Sun

Hewlett Packard/Apollo

IBM

Apple

Silicon Graphics

Phone: 0532 854521

Fax: 0532 853026

C++ Modeling & Simulation Class Library

Object Oriented Technology for Engineering,
Manufacturing, Finance, Education

Meijin++ 2.0

• Integration & Approximation

• Semi-Persistent Containers Royalty Free

• Discrete Event Simulation 115+ Classes

• Optimization & O.R. Starting: \$349.00

• Numerical Analysis 700 Pg User's Manual

• Queuing Systems MS-DOS/Ws, Unix, Sun

• Exceptions Documented Source Code

• Statistics Professional Version Available

Network Integrated Services, Inc.

Tel: +1-714-599-0995 U.S. FAX

221 West Dyer Road +1-714-433-2347

Santa Ana CA 92707

JUST Computer BOOKS

• Struggling with Sage?

• Dicing with DOS 5.0?

• Worried by WordPerfect?

From beginner to expert
We have over 3000 titles to
choose from.

Please phone or write for
your FREE catalogue

111 Court Rd. Malvern
Worcs. WR14 3EF

0684-568095

DO YOU NEED MORE MEMORY?

We have three libraries to
give you just that!

XMEM - Virtual memory Manager using
base, Expanded, Extended or Disk. Replaces
malloc. £145

MEMORY TOOLKIT - Library of routines to
manage Expanded and Extended memory
plus big DOS arrays. £95

EMPTY SHELL - C routines for freeing up
memory when shelling to a large program.
Uses EMS, XMS or disk to swap. £165

Unit 1m, Farrington Fields

Farrington Gurney

Bristol BS18 5UU

Tel 0761 452116

Fax 0761 453226

VAT Extra Carriage Free

Great News!

Object
Oriented
Real
Time
Kernel

for
Turbo Pascal
Now Available
from
JPS Graphics

For more
information call
0244 821009

(Telephone or Fax)

JPS Graphics, 3 Glynne Street,
Queensferry, DEESIDE, CH5 1TA

JPS Graphics

IMPRESS YOUR FRIENDS! LOSE THAT FLAB! IMPROVE YOUR SEX APPEAL!

WRITING FOR .EXE

However, unlike jogging, there
could be some beer money in
it for you. For a copy of our
Contributors' Notes, write to:
*The Editor, EXE Magazine,
10 Barley Mow Passage,
Chiswick, London W4 4PH.*

TAKE UP WEIGHT-LIFTING!

Clipper PostScript Library

Scripton

There are over 50 functions in
Scripton, allowing high definition
text and graphics to be produced
by PostScript printers. Embed
letterheads, logos and graphics in
your Clipper systems.

- Improve report presentation
- Eliminate pre-printed notepaper
- Put picture and graphics in reports

Available from: Price: £155.00 + VAT
QBS Software
10 Barley Mow Passage
London W4 4PH
Tel: 081 994 4842 Fax: 081 994 3441

PostScript Utilities

PostVue £99 + VAT
A visual de-bugger for PostScript code.
Watch your code execute, examine
stacks, dictionaries and state variables.
Set break points, warning levels,
delay times.

PostPP £49.00 + VAT
Un-scrambles PostScript code and lays
it out in human readable form.

PPS £49.00 + VAT
For all PostScript printers. Save paper
with this versatile driver for ascii files.
Output in columns, landscape, choose
fonts, headers, line numbering etc.

Available from:
QBS Software
10 Barley Mow Passage
London W4 4PH
Tel: 081 994 4842 Fax: 081 994 3441

PostScript Library for C

Scripton

The successful Clipper library is
now available for C programmers.

There are over 50 functions in
Scripton, allowing high definition
text and graphics to be produced
by PostScript printers. Embed
letterheads, logos and graphics in
your Clipper systems.

- Improve report presentation
- Eliminate pre-printed notepaper

Available from: Price: £155.00 + VAT
QBS Software (including source)
10 Barley Mow Passage
London W4 4PH
Tel: 081 994 4842 Fax: 081 994 3441

BITON
THE
CLIPPER
ORACLE
LIBRARY



New for April '92 the FoxPro 2.0 Oracle Connections

CLIPPER - BITON - ORACLE GIVES ACCESS FROM PC TO
ORACLE ON - MAINFRAME - MINI - OS/2 OR STANDALONE PC.

INTERESTED IN BITON?

RING: UK (0727) 50658 FAX: UK (0727) 830111

CLIPPER IS A TRADEMARK OF THE NANTUCKET CORPORATION. ORACLE IS A TRADEMARK OF THE ORACLE CORPORATION.

6 Opportunities for Database Specialists

If your skills lie in database design, data management, database administration or data analysis then the market has never been more buoyant, despite the recession. Take a look below.

Ingres Database Design

£22,000

If you have about two years database design experience using the Ingres RDBMS tool-set this market leading GIS systems house can offer a real career opportunity. Experience of graphically-based applications and UNIX is a recommendation.

Cambridge

Ref AS

Database support Analysis

£25,000

Become the "keeper" of a large Object-oriented database that underpins the core business of geo-physical software house. Fluency in 'C' is essential. In-depth knowledge of entity and relationship modelling is vital.

Hants

Ref OS

Head of Software Development

£30,000

Suit a "hands on" software developer with man-management and project control experience gained from a publishing or market communications background. Experience of 'C' programming under DOS or OS/2 and broad experience of database design is essential.

Cambridge

Ref CH

G.I.S. Applications Designer

West Herts**£25,000**

Sound experience of logical and physical database design is the pre-requisite for this challenging new appointment. Your mission will be to build interfaces to 3rd party RDBMS using Arc/Info GIS tools. Expect considerable customer contact.

Ref EUK

MIS Development

Leeds**£23,000**

Become a founder member of a brand new team tasked with creating an integrated Geo-MIS from scratch. Experience of GIS and the use of Oracle System building tools are the primary technical qualifications.

Ref M41

G.I.S. Toolset Development

Maidenhead**£20,000**

Suit an all-rounder with proven skills in the PC and Novell networking areas. Fluency in 'C' and practical experience of MS Windows applications is key. Database design skills and a knowledge of graphics are equally important.

Ref GMS

To apply for one or more of these appointments, please mail a good quality CV to Concurrent Appointments for the attention of Alan Carnell, quoting the appropriate reference(s).



**Concurrent
Appointments**
Software Recruitment

27 FIELD CLOSE
HARPENDEN
HERTS

Tel: 0582 712976
Fax: 0582 764858

Chess Computer Services Ltd

Search, Selection and Advertising Consultants, Park House, Greenhill Crescent, Watford Business Park, Hertfordshire, WD1 8QU

SENIOR UNIX SOFTWARE ENGINEERS - £30K + Car + Bens.

With an intimate knowledge of the UNIX operating system down to kernel level. This industry is recruiting UNIX specialists with strong C programming skills. Numerous LAN support vacancies for recruits with experience in one of the following - to £35K: LAN Manager Novell Lan Server Vines, TCP/IP, UNIX

INFORMIX SENIOR SYSTEMS DESIGNER - To £30K

Top city based consultancy need good Informix, C and UNIX skills to oversee a variety of large projects.

WORLD CLASS NETWORKING SOFTWARE ENGINEERS £25K

To design and develop LAN products, working in C & Assembler.

SYBASE - ANALYST PROGRAMMER £18 - £25K

Top Comms company require analyst programmer to develop in-house database.

PARADOX - ANALYST PROGRAMMER - £20K

With in-depth knowledge of PAL. Any financial or retail experience desirable.

AS400 SENIOR ANALYST PROGRAMMER - £25K

RPG 400 analyst programmer to lead a team of four within this major vehicle manufacturer.

C LAN PROGRAMMER - £25K

Experience of working in a DOS environment, OSI/X.25 skills

C++ PROGRAMMER - £25K

Ambitious graduate calibre developers to join this international software services company.

UNIX SOFTWARE ENGINEER - £25K

Working to Kernel level porting applications to different hardware platforms.

UNIX SUPPORT - £20K + Car

UNIX and Uniplex experience to configure, administer and customise Uniplex for customer requirements.

CLIPPER ANALYST & PROGRAMMERS - To £28K + banking benefits

Merchant bank requires junior and senior Clipper professionals for back office database development.

C PROGRAMMERS INTERNATIONAL BANK - £25K + bank benefits

To develop front end dealing room systems for this prestigious institution.

TOP CLASS SOFTWARE ENGINEERS to £25K

To design and implement network drives working in C and Assembler on local and wide area networks.

COMMUNICATION MANUFACTURER - Up to 25k

Seek Software Engineers 3 years + Experience. This role will suit bright individuals with a background in the following areas: OSI upper layer protocols Network Management forum and/or SNMP implementations. Use of object oriented techniques RPC protocols C in a VAX/VMS or UNIX environment.

VAX COBOL ANALYST PROGRAMMERS - £ + Banking Benefits

Our client is a house hold name in the banking arena. They are currently looking to take on people with 18 months to 2 years with the following experience: VAX COBOL DEC FORMS ACMS Rdb SQL and CDD

GRADUATES - £14k

Take on a new and exciting position with one of the leading network and communications manufacturers. All you need is a good educational background ideally 3 A Levels A Grade 1 year in Industry Developing in C or C++ on a VAX experience and a 2.ii in maths.

VAX ORACLE DEVELOPER - £23 + Banking Benefits

Fast moving independent city institution are looking for enthusiastic and energetic professionals. Knowledge and good practical experience in ORACLE up to the latest version Oracle Case Directory, 4GL tools with a flexible outlook, willingness to support systems as well as develop, understand management/unit trust administration.

C/ASSEMBLER SOFTWARE ENGINEER

To carry out pre + post production developments on PC products. Job requires knowledge of assembler and C programming and experience of a real time environment in circuit emulation.

BUSINESS ANALYST - £25K

Major Insurance group are seeking a business analyst to develop their sophisticated point of sale product

IF YOU HAVE EXPERTISE IN THE ABOVE OPPORTUNITIES OR YOU ARE SIMPLY A COMPUTER PROFESSIONAL LOOKING FOR A NEW POSITION CALL NOW FOR VACANCY DETAILS IN SALES SUPPORT DEVELOPMENT

RONICOM

RECRUITMENT

5-7 Sedley Place (off Oxford Street), London W1R 1HH
 Tel: 071 491 3640 Fax: 071 499 2546

Technical Manager Cambs up to £25k
 To manage this small team, you must have the minimum of three years proven managerial experience, and be a skilled communicator with the non computer literate individuals in the company. Extensive knowledge of C coding and CD-Roms within a databasing environment and GUI front ends are essential to the role. The company has a great track record and offers attractive benefits.

Software Engineers Herts up to £18k
 2nd jobbers required for an interesting image processing project. Relevant skills include: Image storage, C and UNIX, within a Mac, Sun and RS6000 environment. You must be interested in developing your skills further and have a suitable structured coding background. Enthusiasm is essential

Software Product Developer London £18k
 Are OOD, C SQL your kind of thing? This innovative company is interested in the Mac approach to GUIs but on PCs under OS/2 with use of Applications Manager and perhaps even Smalltalk.... It is a challenging role and they are looking for the final member of the team. You must be a calibre Computer Science graduate with a good software engineering background behind you. As an extra incentive, there will be an equity deal involved when the product is released.

OSI C Windows Specialist SW London £Neg
 This well known OSI Software and Hardware interfacing development house is looking for a skilled individual with at least four years experience. You should have a good knowledge of comms protocols, and be prepared to be an instrumental player in future development strategies. In return there will be good benefits and bonuses, the recession has not effected this company.....

Systems Programmer Berks £Good
 This position will involve work on various file handling products (including a new 64-bit file handler capable of processing very large files), and the utilities that will be needed to use the new file handler. You will need at least 2-3 years experience in a systems programming environment, a knowledge of indexed file structures (balanced B-trees), C, UNIX, OS/2 and some Micro Focus Cobol. The work will be done mainly under OS/2, with some UNIX. The company is an extremely successful Software House and offers unparalleled benefits and experience.

MAC Database S/W Developer London £Above Industry Rates
 An innovative Mac Software House is looking for a cocktail of MAC development skills, (not DTP at all!) Including 4th dimension, Omnis, MPW, C, and Mac App in the kind of areas in which expertise is required. Some interesting developments are promised and I am certain that your career can only benefit from joining this outfit.

OSF Motif-X-Windows UNIX Developers Cambs £23k
 This renowned Company is heavily involved with UNIX Windows and Utility development, and is desperate for some extremely skilled individuals. You should have a good development background and be used to dealing with clients/end-users in tailoring to specific requirements. There should be some international travel involved, (User group and conferences, etc) and you should feel confident in your own abilities. Being a graduate is not necessarily a prerequisite, but being an able developer is....

Sybase/Oracle/Ingres London/Scotland £20k
 This Software House is looking for two likely candidates ASAP for a specialised development project. There will be some necessary travel between the two sites, and if you are prepared for this, then there will be good prospects offered in return.

Quick Basic Developer Avon £Neg
 This Systems House is looking to expand its development team and wants some really bright QuickBasic coders with inherent abilities in either C or 80x86. Be prepared for lots of work but good rewards.

C Realtime Embedded Systems Dorset £Good
 Using Assembler and C within a PC environment, and utilising ICE and Yourdon conventions, a wide range of experience will be considered as a flexible development approach is essential. This is a commercial project, not military so the work looks set to continue... Preferably you will be a graduate in Software Engineering or a related discipline.

Low-level BIOS 80x86 Expert Surrey £20k
 This is a demanding company and they are offering a demanding role that presents the successful applicant with a good opportunity to work for one of the GB's most innovative OEMs, need I say more?

If any of these positions are at all suitable, or even if your skills are not quite what is required, do not hesitate to give **Mike Dearing** a call on 071 491 3640 or after hours on 081 767 1003

PEOPLE IN UNIX*

GET INTO GEAR
 PREPARE FOR THE UPTURN

*Unix is a trademark of AT&T

ACTIS
 is seeking people
 with good technical
 experience of **OPEN SYSTEMS**
 which is still a growing sector
 of the IT market.

We have a number of instructions in
 the North and Midlands and we are looking
 for people with specific skills in:

Networking and Communications,
Relational Database/SQL
4 GLs, CASE, IPSE
C and WINDOWS
Accounts/Commercial and
Scientific Programming
Training and Documentation
Technical Sales

We are seeking consultant, project management, development and support staff from graduate trainees to those with ten years experience.

To discuss these and other opportunities talk to **Honor Lindsey** on (0204) 20200 or send your CV to **ACTIS RECRUITMENT**
 17 CHORLEY NEW RD, BOLTON BL1 4QR

ACTIS
 PEOPLE IN UNIX*



Are YOU looking for PC Systems Analysts, C Programmers, PC Support Analysts, Unix Gurus, S/W Development Engineers, Network Specialists, Object Oriented Systems Designers, Real Time Engineers, Database Developers, Application Support Engineers, Windows Programmers, CAD CAM Experts, Graphics Specialists....and more?

LOOK NO FURTHER THAN THESE PAGES.

Call us on 081-994-6477 to find out more about this unique advertising medium.

Of course they all come with their experience in ADA, PASCAL, ORACLE, C, C++, WINDOWS, CLIPPER, MOTIF, SQL, CAD-CAM, ASSEMBLER, LANs, WANs, dBase UNIX.....

.EXE - We only provide the best!

the soft (corporation)

Specialists in relational databases, open systems and structured techniques.

ORACLE/SQL/ EMBEDDED SQL

Candidates with skills in SQL and embedded SQL are immediately required by clients involved in applications as varied as financial information systems to pan European manufacturing/distribution and leasing systems. Strong SQL experience coupled with low-level language interfaces to 3GL's and screen painting methods are important. Training in the latest Oracle tools and methods given where necessary. The new and existing implementations are running under VMS, ULTRIX, UNIX and sunOS with some links to multi-user PC systems. Other database knowledge may also be of interest.

£12,000-35,000+
Ref SC/1/exe

INGRES

Excellent opportunities exist for any INGRES development staff from Programmers up to Project Manager level. Candidates will be using the most advanced development tools available with companies investing in leading edge technology. INGRES/STAR, GUI's, SQL and OPEN SQL, decision support/application development tools, user interfaces and structured methods (SSADM, YOUSDON, JACKSON), C, COBOL, are the priorities. Potential to work across varied hardware platforms is also a preference. Opportunities exist in Banks, Building Societies, Software and Systems Houses and Governmental Bodies.

£12,000-35,000+
Ref SC/2/exe

SOFTWARE DEVELOPERS

SYBASE, INGRES, INFORMIX, ORACLE, UNIFY, CLIPPER, PRO IV, POWERHOUSE, RDB, ALL, SEACHANGE, PROGRESS, SB+, INFORMATION and interfaces to 3GL's - C, C++, PASCAL and FORTRAN and even COBOL and BASIC! Our client companies require candidates with the following skills: Technical Software Development, Software Engineering, Pre/Post Sales, Database Design and Systems Consultancy. Areas of particular interest include: Distributed Systems, Object Oriented Databases, LANs, WANS, Graphics Image Processing, Windows, Formal Design Methodologies, CASE Tools, Expert Systems, Knowledge Engineering, Office Automation, Compilers, Low Level Design, Data Integration and varied application design. COMPUTER POLYGLOTS need apply!

£12,000-40,000
Ref SC/6/exe

DATABASE DESIGN

Developments as varied as Voice-activated relational database recognition systems, Protocol enhancement/transport, session and presentation level and World-wide communications systems utilising LAN's and WAN's across different hardware platforms are currently available. Experience of ETHERNET, TCP/IP, NFS, X25, X400, X600 in a UNIX, VMS, sunOS and also fault tolerant environments are required. Some exposure to structured methods and other leading edge technology would be a bonus, though training will be given. Knowledge of industry standards and committees is also relevant at more senior levels. UNIX Kernel knowledge is at a premium.

£12,000-£35,000
Ref SC/4/exe

COMMUNICATIONS/ NETWORKING

Developments as varied as Voice-activated relational database recognition systems, Protocol enhancement/transport, session and presentation level and World-wide communications systems utilising LAN's and WAN's across different hardware platforms are currently available. Experience of ETHERNET, TCP/IP, NFS, X25, X400, X600 in a UNIX, VMS, sunOS and also fault tolerant environments are required. Some exposure to structured methods and other leading edge technology would be a bonus, though training will be given. Knowledge of industry standards and committees is also relevant at more senior levels. UNIX Kernel knowledge is at a premium.

£12,000-£35,000
Ref SC/4/exe

X WINDOWS/ MS-WINDOWS/MOTIF

Graduates (1 year+) to Senior Software Engineers with an interest in advanced development environments need apply for varied positions with companies dedicated to leading edge technology. A mixture of the following skills in a development environment are preferred: GUI's, Document Image Processing, OCR technology, Client/Server applications and WYSIWYG techniques coupled with experience of UNIX, sunOS, MS-DOS, or ULTRIX/VMS and Interfaces to relational (primarily INGRES or SYBASE) and Networking (TCP/IP, NFS, X400) technology. Application areas vary from Retail, distribution to finance and Software Vendors to End User environments.

£12,000-35,000 + BENEFITS
Ref SC/5/exe

SOFTWARE ENGINEERS

Clients-End-Users, Software Vendors and Software Houses dedicated to strategic implementation of leading edge technology and integration of applications across different hardware and operating systems platforms require candidates to degree level with a scientific/technical development bias and a 1-3 years experience. There are two main options:-

TECHNICAL DEVELOPMENT:

Continued use of UNIX, VMS, MS-DOS, C, Windows, Pascal, C++, Ada, Prolog, OPS, Networking and Communications with companies offering technology based careers and management responsibility.

COMMERCIAL DEVELOPMENT:

Using technical skills already developed, but offering opportunities to apply analysis and design skills rather than remain a 'technical guru'. Please call to discuss your particular career path, growth and potential.

£12,000-25,000 + BENEFITS
Ref SC/7/exe

INFORMIX/CLIPPER

Clients involved in small to medium database projects (10 to 35 users) utilising products like INFORMIX, CLIPPER, DBASE IV and FOXBASE require Programmers Analyst/Programmers with 4GLs, C, Pascal, Turbo Pascal, Quickbasic etc... or some of these skills for new and existing developments. Potential to get involved in Networking projects and in some cases larger scale projects involving cross-training also exist.

£12,000-22,000
Ref SC/9/exe

STOP PRESS

Pre/Post Sales UNIX Systems London, SQL Systems Consultant - Berk/Surrey/London, UNIX Systems Administrators - All Areas.

£12,000-40,000 + BENEFITS
Ref SC/8/exe

CONTRACT AND PERMANENT POSITIONS ARE UK WIDE, SO PLEASE TO DISCUSS YOUR PARTICULAR SKILLS AND REQUIREMENTS.

The Soft Corporation Chancery House 319 City Road London EC1V 1LJ Tel: 071 609 5501 Fax: 071 700 5787



WEST YORKSHIRE

Support Programmer

META4 4GL under UNIX

£12,000

Customer Support

for a large multi-national will lead to Oracle support work

£14-15,000

UNIX Technical Manager to provide a strong lead to a large software development team

Around £35,000 + Car + extensive benefits

COBOL Programmers

to £14,000

4GL Programmers under UNIX

(INGRES an advantage)

to £14,000

For your next career move around West Yorkshire telephone Vincent Atherton on Leeds (0532) 504560 or write to:

AIREDALE RECRUITMENT

Realtex House, Micklefield Lane, Rawdon, Leeds, LS19 6AX

AIREDALE RECRUITMENT

ASH ASSOCIATES

We specialise in the Recruitment of Software Design Engineers for the South East in Real Time Applications, Graphics, Communications, Control/Robotics, Signal/Image Processing & Modelling.

OUR GUARANTEE

EMPLOYERS: Ash Associates offer you a personal service where we guarantee that an applicant we introduce to you is interested in and is suitable for the position you are offering.

APPLICANTS: We will only put you forward for a position where we feel you have the right experience and will be of interest to you. In addition if we do not have the right position on our current files we will endeavour to find the right position for you.

LATEST OPPORTUNITIES

Telecoms Research Hants

This Telecommunications Research company a joint venture between Major European manufacturers are expanding their Software Teams working on New and Original projects for advanced Telecommunications Systems.

They seek highly qualified graduate engineers at all levels with a minimum of 2 yrs experience in software design gained in a Telecoms or High Technology environment. Areas of interest include Artificial Intelligence, Personal Telecoms, Security Systems, Transputers, Bit Slice, C, 16-32 bit Assemblers, Unix, DOS, VAX/VMS.

Real Time Systems London

This High Technology designer of state of the Art Scientific and Instrumentation systems are expanding. They seek additional Young Graduates with at least 2 yrs experience of software design gained in a similar High Technology environment. C, Unix, Real Time Kernel, Embedded Systems, Youdon.

Call James Hunt or Ron Cook NOW!
Tel: (0425) 475480 (24hrs) Fax: (0425) 480807

ASH associates

RECRUITMENT CONSULTANTS
3 Pipers Ash, Ringwood, Hants, BH24 1UF

ADVERTISERS INDEX

| ADVERTISER | PRODUCT/SERVICE | CIRCLE | PAGE | ADVERTISER | PRODUCT/SERVICE | CIRCLE | PAGE |
|----------------------------|---------------------------------|---------|------|------------------------|----------------------------|--------|-------|
| AI International | OOP Language & Environments | 603 | 58 | Lahey | Fortran Compiler | 553 | 27 |
| Applied Logic | Object Oriented Programming | 574 | 55 | LPA | AI/KB/OOPS Software | 581 | 67 |
| Automated Office Systems | Networking | 537 | 5 | Magnifeye | Software Protection Device | 589 | 76 |
| Barnet Electronics | PC Hardware | 591 | 79 | Microcosm | Copy Control | 554 | 27 |
| Biton | Clipper Software | 605 | 92 | Microphar | Software Protection | 567 | 46 |
| Bits Per Second I | Graphics for Visual Basic | 571 | 53 | Microsoft Press | Book Publishers | 550 | 25 |
| Bits Per Second II | Graphics for Clipper | 587 | 75 | Microware | Real Time | 564 | 43 |
| BL Computer Security | Security Dongle | 597 | 87 | MKS | UNIX Under DOS Tools | 594 | 83 |
| Blink | Clipper Fast Linker | 586 | 73 | Network Research | Networking | 583 | 67 |
| Borland | C++ Video Course | 601 | 27 | Next | Workstation | 542 | 14 |
| Brent Communications | MAX copy Protection | 549 | 25 | Nu-Mega | Debugging Tools | 541 | 13 |
| BSO Tasking | Real Time Executive | 596 | 86 | Positive Ltd | Editor | 547 | 20 |
| Cocking & Drury | SmallTalk V | 539 | 8 | QA | C Training | 535 | IFC |
| Contrast Systems Ltd | SQL Database Systems | 556 | 33 | QBS | Clipper Function Library | 562 | 89 |
| CTL | Copy Protection Hardware | 575 | 55 | Readmar Systems Ltd I | Tools | 578 | 19 |
| Custom Business Software | Comms Software | 582 | 80 | Readmar Systems Ltd II | Version Control | 600 | OBC |
| DES | Software Protection | 590 | 77 | Salford S/W Marketing | FORTRAN for DOS & UNIX | 577 | 61 |
| Evergreen | CASE Tools | 604 | 29 | Seitec | Software Testing | 606 | 89 |
| Expertech | Pro-C | 548/563 | 23 | Software Con. Co. I | Development Tools | 568 | 49 |
| F1 Computing Services | Training | 543 | 17 | Software Paradise | Development Tools | 579 | 62/63 |
| Facts Direct | FAX Service | 569 | 50 | Software Security | Security Products | 540 | 11 |
| dLesco | Clipper Function Library | 599 | IBC | System C | Application Generator | 585 | 70 |
| G-Force | Graphical Interface for Clipper | 572 | 53 | System Science | Maths Software | 559 | 37 |
| Glockenspiel | Class Constructors | 538 | 7 | System Star I | Software Tools | 602 | 25 |
| Grey Matter | Programming Tools | 536 | 3 | System Star II | Chart Drawing Software | 555 | 29 |
| GWI | Software Design Tools | 582 | 67 | System Star III | DOS Extender | 561 | 41 |
| Highland Grafix | GUI Software | 573 | 54 | System Star IV | Information Manager | 598 | 41 |
| Hitek | Embedded Systems | 552 | 28 | The Instruction Set | Training | 557 | 35 |
| Inst. Analysts/Programmers | Institute | 545 | 19 | Thripplewoods | Sanyo Special Offer | 595 | 85 |
| Intasoft | Software Management System | 558 | 36 | TKH International | Data Compressions | 560 | 38 |
| ITEL | Applications Generator | 551 | 26 | USA Software | Programming Tools | 566 | 45 |
| IXI | Motif | 584 | 69 | User Friendly | Software Copy Protection | 588 | 75 |
| JPI I | C++ Compilers | 544 | 17 | Watcom | Compiler | 570 | 51 |
| JPI II | C++ Compilers | 546 | 19 | Xoren | File Transfer Software | 580 | 64 |

STOB - A favourite phrase

'One two! One, two! and through and through / The vorpal blade went snicker-snack! /
He left it dead, and with its head / He went galumphing back.'

is (of course) bandersnatched from one of the action stanzas of *Jabberwocky*, Lewis Carroll's nonsense poem from (Alice) *Through the Looking Glass*. I thought I would try it out for size, as it were.

To explain: some time ago, an Admirer wrote to me saying, why don't you write a book? Well, I gave it some thought, and the long and short of it is that my *magnum opus*, provisionally entitled *The Art of Computer Programming*, Vols 4-10, is now well under way. But there is much more, I find, to writing a proper computer book than slapping down a few algorithms, banging in an index and faxing the first draft ms through to Messrs Addison-Wiley. Oh yes.

For a start, it's vital to have a soppy dedication at the front, but that's a cinch ('To darling Parity, without whose sisterly support and succour...'). What's brought me up is the little quote that must be provided at the beginning of each chapter. Because you can't just stick in anything you like, you know. There is a strict and heavily policed code - an informal ISO standard, if you like. Any author quoting from, say, the

short stories of DH Lawrence risks being laughed out of the BCS. Contrariwise, don't go quoting David Bowie unless you wish to declare yourself a hopeless reverse-snob.

No, a rough, ranked list of acceptable sources for quotations in computer science works is: 1) Lewis Carroll, 2) JRR Tolkien (Hobbitry), 3) The Shakespeare Play you did for O-level, 4) Any colleague at the computer lab, 5) L Frank Baum (Ozery), 6) Somebody who has written a similar text book, 7) Any great scientist from Archimedes through to Rutherford - score double points for obscure ones, 7.5) Countess Ada Lovelace 8) Anybody else, male, and 25) Anybody female.

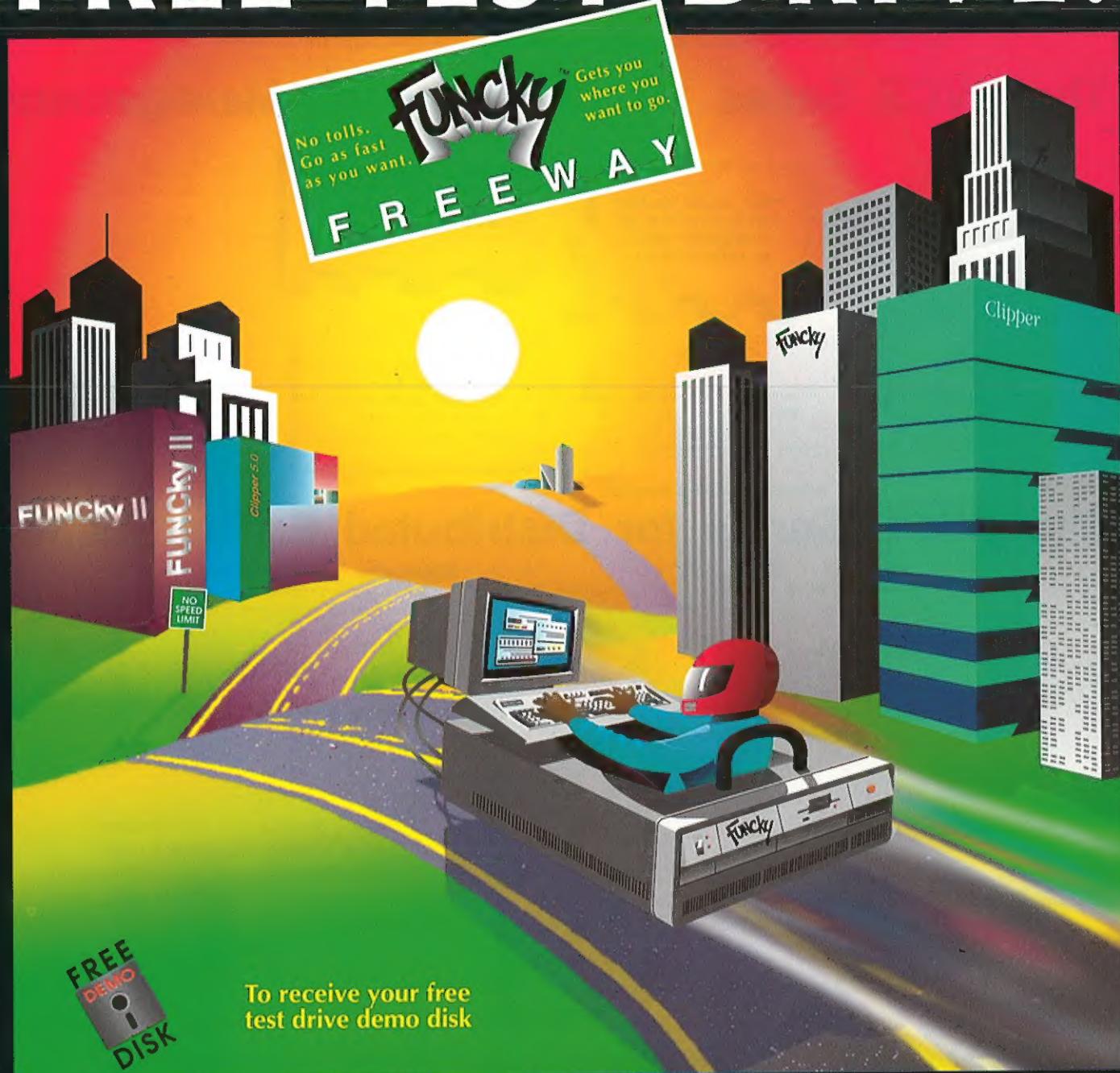
To see how this works, let's analyse a real book. In Bjarne Stroustrup's *The C++ Programming Language* (2nd Ed) I found 15 chapter heading quotations. I am unable to identify CN Parkinson, Jon Bentley, L Peter Deutsch and F Brooks, better-informed, letter-writing readers may be able to put me straight. For the rest, we have a (slightly mangled?) Henry VI Pt 2, a saying of Bilbo Baggins the Hobbit (at least it

wasn't one of those terrible elf-songs which make *Lord of the Rings* the book it is), two bits from *Alice*, three quotes of categories 4) and 6), William of Occam (philosopher, mathematician, manufacturer of men's toiletries), W Churchill (huh?), an Einstein and, in Chapter 8 (Templates), a cop-out. It just says 'Your quote here - B Stroustrup'.

Now if a writer of Stroustrup's calibre runs out of original and/or apt quotes, what chance V Stob? I considered inventing a few likely phrases based on what I could remember about Lewis Carroll - ie that he was a rather suspect old gentleman with a penchant for photographing little girls clad only in their birthday suits - but could only come up with 'Togs off, Violet - the camera's ready!', which is of no use to anyone.

Stuff it! I'm going to go my own sweet way, and damn the critics. Chapter 1. The Importance of OOP. *Marilyn Monroe, on being offered matzo balls for the third time by her mother-in-law: 'Isn't there any other part of a matzo you can eat?' Watch out, Knuth, here I come.*

FREE TEST DRIVE!



Try our innovative TEST DRIVE program, a free demo of the FUNCKy library which you can actually program with. Edit code using any or all of the FUNCKy library, then compile, link and run to find out for yourself why FUNCKy is the ultimate Clipper Developer's tool.

The FUNCKy add-in library for Clipper contains over 450 functions which can be used as if they were a part of the Clipper language itself. Extensive features include moveable resizeable windows with mouse support, superior DOS file handling, blazing fast string manipulation, and impressive video control.

Get FUNCKy now and get the phenomenal programming power you need to create the advanced applications demanded of you in today's competitive development environment.



dLESKO
INCORPORATED
320 York St., Jersey City, NJ 07302
FAX # 201-435-0637

© 1991 dLESKO Inc. All rights reserved. FUNCKy and dLESKO are trademarks of dLESKO Inc. Clipper is a trademark of Nantucket Corp. Graphics by MicroArts. © 1991 MADvertising.

Contact QBS Software

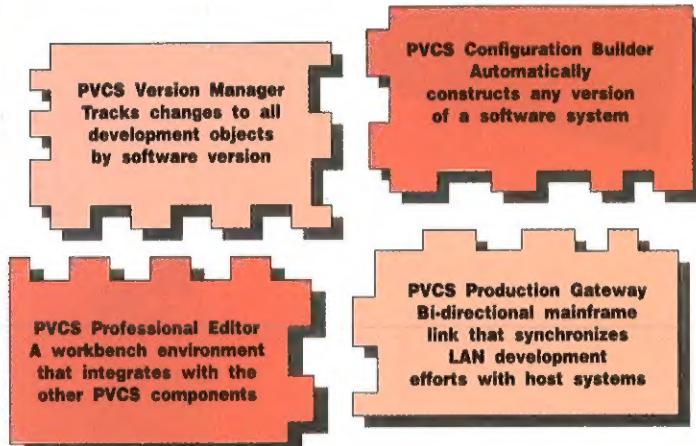
Telephone: +44 81 994 4842
Fax: +44 81 994 3441
BBS: +44 81 747 1979

CIRCLE NO. 599

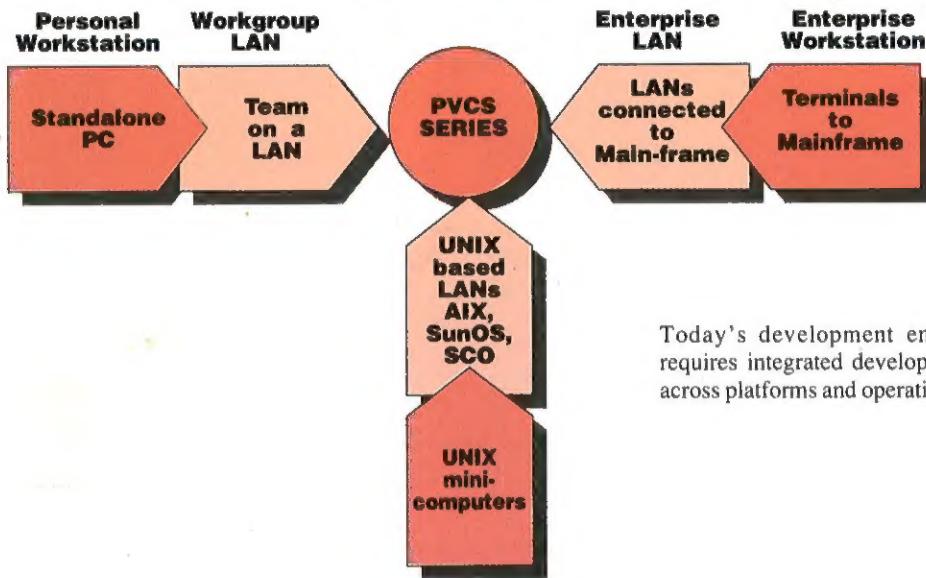
Maximise Productivity, Minimise Mistakes

To produce and maintain reliable software requires a comprehensive configuration management strategy. This strategy must support work group development on LANs, with distribution across multiple servers, wide area networks, and host systems.

The PVCS Series for Configuration Management



The PVCS Series for Distributed Environments



Support for UNIX and heterogeneous workstation and LAN environments.

To optimise the use of resources, it is imperative for the configuration management system to distribute the required functionality to appropriate platforms. This means the manager must operate seamlessly across PC-DOS, OS/2, LANs and a variety of UNIX systems. This protects your organisation's investment in existing technology and assures compatibility for future growth.

Current prices for single users:

| | | | |
|---------------------|-------------|----------------------------|--------------------------------|
| DOS or OS/2 or UNIX | : PVCS £345 | Configuration Builder £149 | PVCS Professional Editor* £99 |
| DOS and OS/2 | : PVCS £445 | Configuration Builder £199 | PVCS Professional Editor* £125 |

* On Special Offer

Tel (+44) 071 625 5255
Fax (+44) 071 624 9404

Readmar Systems
L I M I T E D

Sales and Support for
Development Software

CIRCLE NO. 600